

U.S. Environmental Protection Agency Region II SDMS Document





esponse Action ontract

Final Work Plan

for

Remedial Investigation/Feasibility Study
Cornell-Dubilier Electronics Superfund Site
South Plainfield
Middlesex County, New Jersey

MARCH 2000

Contract No: 68-W-98-214



USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
WORK PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

NOTICE

THE INFORMATION PROVIDED IN THIS DOCUMENT HAS BEEN FUNDED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) UNDER RAC II CONTRACT NO. 68-W-98-214 TO FOSTER WHEELER ENVIRONMENTAL CORPORATION (FOSTER WHEELER ENVIRONMENTAL). THIS DOCUMENT HAS BEEN FORMALLY RELEASED BY FOSTER WHEELER ENVIRONMENTAL TO THE USEPA. THIS DOCUMENT DOES NOT, HOWEVER, REPRESENT USEPA POSITION OR POLICY, AND HAS NOT BEEN FORMALLY RELEASED BY THE USEPA.

Tech\RAC\Cornell_Dub\WP.wpd 300002



FOSTER WHEELER ENVIRONMENTAL CORPORATION

March 22, 2000 RACII-2000-066

Mr. John Bachmann, Jr Contracting Officer US Environmental Protection Agency 290 Broadway, 27th Floor New York, NY 10007-1866

Mr. Keith Moncino Project Officer US Environmental Protection Agency 290 Broadway, 18th Floor New York, NY 10007-1866

SUBJECT: RAC II PROGRAM - CONTRACT NO. 68-W-98-214

CORNELL-DUBILIER ELECTRONICS SITE WA NO. 018-RICO-02GZ

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

SUBMISSION OF FINAL WORK PLAN AND HUMAN HEALTH RISK

ASSESSMENT PATHWAYS ANALYSIS REPORT

Ref:

EPA Comments on Draft Work Plan and Pathways Analysis Report Received

28 January, 2000

Dear Mr. Bachmann and Mr. Moncino:

Foster Wheeler Environmental Corporation (FWENC) is pleased to submit three (3) copies each of the Final Work Plan and Human Health Risk Assessment Pathways Analysis Report (PAR) for the Remedial Investigation/Feasibility Study (RI/FS) for the Cornell-Dubilier Electronics Superfund Site for your review and approval. The Final Work Plan and PAR include revisions that address EPA's comments dated 28 January, 2000 and subsequent discussions with the EPA WAM and technical specialists. Included in the Appendix to the Work Plan are the Quality Assurance Project Plan and the Environmental Health and Safety Plan.



Mr. John J. Bachmann, Jr. Mr. Keith Moncino March 22, 2000 Page Two

If you have any questions regarding the Work Plan or PAR, please do not hesitate to contact me at (973) 597-7034 or Dr. Daniel Miller, the Project Manager, at (973) 597-7107.

Very truly yours,

Dev R Sachdev, PhD, PE RAC II Program Manager

Attachment

cc:

M. S. Alvi

P. Mannino

(w/o attachment) USEPA (w/ attachment) USEPA

M. Kuo R. Hill D. Miller Project File

USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
WORK PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

Prepared by:

Daniel M. Miller, Ph.D.

Project Manager

Foster Wheeler Environmental

Reviewed by:

Ming Kuo, Ph.D., P.E.

RAC II Technical Quality Control Manager

Foster Wheeler Environmental

Approved by:

Dev Sachdev, Ph.D., P.E.

RAC II Program Manager

Foster Wheeler Environmental

TABLE OF CONTENTS

Section		<u>Title</u>	<u>Page</u>
1.0	INTRODUCTION		1-1
	1.1 1.2	PURPOSE BACKGROUND 1.2.1 Site Location and Description 1.2.2 Site History	1-1 1-2 1-2 1-5
		1.2.3 Site Geology and Hydrogeology	1-8
2.0	<u>SUM</u>	MARY OF SITE CONTAMINATION	2-1
	2.1 2.2 2.3 2.4 2.5 2.6	SUMMARY OF DETECTED CONTAMINANTS SURFACE AND SUBSURFACE SOIL CONTAMINATION SEDIMENT AND SURFACE WATER CONTAMINATION BIOTA CONTAMINATION BUILDING WIPE, CHIP, AIR, AND DUST CONTAMINATION GROUNDWATER	2-1 2-2 2-3 2-3 2-4 2-4
3.0	<u>TAS</u>	K PLAN FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY	3-1
	3.1	TASK 1 - PROJECT PLANNING AND SUPPORT	3-1
	2 2	3.1.1 Project Administration 3.1.2 Conduct Site Visit 3.1.3 Attend Scoping Meeting 3.1.4 Develop Draft Work Plan and Associated Cost Estimate 3.1.5 Negotiate and Revise Draft Work Plan 3.1.6 Evaluate Existing Data and Documents 3.1.7 Quality Assurance Project Plan 3.1.8 Health and Safety Plan 3.1.9 Non-RAS Analyses 3.1.10 Meetings 3.1.11 Subcontract Procurement 3.1.12 Perform Subcontract Management 3.1.13 Pathway Analysis Report	3-1 3-2 3-2 3-3 3-3 3-3 3-4 3-5 3-5 3-5 3-6 3-7
	3.2	TASK 2 - COMMUNITY RELATIONS	3-7
		 3.2.1 <u>Community Interviews</u> 3.2.2 <u>Community Relations Plan</u> 3.2.3 <u>Public Meeting Support</u> 	3-7 3-7 3-8

TABLE OF CONTENTS (Cont'd)

Section		<u>Title</u>	Page
	3.2.4	Fact Sheet Preparation	3-9
	3.2.5		3-9
	3.2.6	Public Notices	3-10
	3.2.7	Information Repositories	3-10
	3.2.8	Site Mailing List	3-11
	3.2.9	Responsiveness Summary Support	3-11
3.3	TASK	X 3 - FIELD INVESTIGATION	3-11
	3.3.1	Site Reconnaissance	3-15
	3.3.2	Mobilization and Demobilization	3-27
	3.3.3	Hydrogeological Assessment	3-27
	3.3.4	Soil Boring, Drilling, and Testing	3-29
	3.3.5	Environmental Sampling	3-29
	3.3.6	Ecological Characterization	3-41
•	3.3.7	Geotechnical Survey	3-41
	3.3.8	Investigation-Derived Waste (IDW) Characterization and	
		<u>Disposal</u>	3-41
3.4	TASK	X 4 - SAMPLE ANALYSIS	3-41
	3.4.1	Innovative Methods/Field Screening Sample Analysis	3-42
	3.4.2	Analytical Services Provided via CLP or DESA or USEPA-ERT	3-42
	3.4.3	Analytical Services Provided via Subcontract Laboratories	3-42
3.5	TASK	5 - ANALYTICAL SUPPORT AND DATA VALIDATION	3-42
	3.5.1	Collect, Prepare and Ship Samples	3-42
	3.5.2	Sample Management	3-43
	3.5.3	Data Validation	3-43
3.6	TASK	K 6 - DATA EVALUATION	3-43
	3.6.1	Data Usability Evaluation	3-44
	3.6.2	Data Reduction, Tabulation and Evaluation	3-44
	3.6.3	Modeling	3-45
	3.6.4	Technical Memorandum (Data Evaluation Report)	3-45

TABLE OF CONTENTS (Cont'd)

Section	<u>Titl</u> e	Page
3.7	TASK 7 - ASSESSMENT OF RISK	3-45
	3.7.1 Baseline Risk Assessment (Human Health)	3-45
	3.7.2 <u>Baseline Risk Assessment - Ecological Risk Assessment</u>	3-46
3.8	TASK 8 - TREATABILITY STUDY AND PILOT TESTING	3-49
	3.8.1 <u>Literature Search</u>	3-49
	3.8.2 <u>Treatability Study Work Plan</u>	3-49
	3.8.3 <u>Conduct Treatability Studies</u>	3-50
	3.8.4 <u>Treatability Study Report</u>	3-50
3.9	TASK 9 - REMEDIAL INVESTIGATION REPORT	3-51
	3.9.1 <u>Draft Remedial Investigation Report</u>	3-51
	3.9.2 Final RI Report	3-61
3.10	TASK 10 - REMEDIAL ALTERNATIVES SCREENING	3-61
	3.10.1 Draft Remedial Alternatives Technical Memorandum	3-61
	3.10.2 Final Remedial Alternatives Technical Memorandum	3-62
3.11	TASK 11 - REMEDIAL ALTERNATIVES SCREENING	3-62
	3.11.1 Draft Remedial Alternatives Evaluation Memorandum	3-64
	3.11.2 Final Remedial Alternatives Evaluation Memorandum	3-65
3.12	TASK 12 - FEASIBILITY STUDY REPORT	3-65
	3.12.1 <u>Draft Feasibility Study Report</u>	3-65
	3.12.2 Final Feasibility Study Report	3-65
3.13	TASK 13 - POST RI/FS SUPPORT	3-65
	3.13.1 Feasibility Study Addendum	3-66
3.14	TASK 14 - NEGOTIATION SUPPORT	3-66
3.15	TASK 15 - ADMINISTRATIVE RECORD	3-66

TABLE OF CONTENTS (Cont'd)

Section		<u>Titl</u> e	
	3.16	TASK 16 - WORK ASSIGNMENT CLOSEOUT	3-66
		3.16.1 Work Assignment Closeout Report (WACR)	3-66
		3.16.2 <u>Document Indexing</u>	3-67
		3.16.3 <u>Document Retention/Conversion</u>	3-67
		3.16.4 Package and Return Documents to Government	3-67
4.0	<u>PROJ</u>	ECT MANAGEMENT APPROACH	4-1
4.1	PROJ	ECT ORGANIZATION	4-1
4.2	PROJ	ECT SCHEDULE	4-1
4.3	COST	Γ ESTIMATE	4-6
5.0	REFE	ERENCES	5-1

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1-1	Site Location Map	1-3
1-2	Site Map	1-4
3-1	Potential Reconnaissance Phase and Phase I Investigation Sampling Locations	3-16
3-2	Residential Properties Southeast of Site	3-19
3-3	Residential/Commercial Properties West of Site	3-20
3-4	Residential/Commercial Properties Southwest of Site	3-21
3-5	Residential/Commercial Properties Northwest of Site	3-22
3-6	Potential Geophysical Survey Area and Soil Gas Survey Locations	3-24
4-1	Project Organization Structure	4-2
4-2	Project Schedule	4-5
	LIST OF TABLES	
<u>Table</u>	Title	<u>Page</u>
3-1	Summary of Reconnaissance Phase and Phase I Investigation Program,	
	Rationale and Analyses	3-12
3-2	Summary of Analytical Program-Reconnaissance Phase and	
	Phase I Investigation	3-14
3-3	Summary of Residential and Commercial Soil Sampling Locations	3-18
4-1	Summary of Major Deliverables for the Remedial Investigation/	
	Feasibility Study at Cornell-Dubilier	4-3

DISTRIBUTION OF WORK PLAN

Project Manager - Foster Wheeler Environmental Corporation
Site QA Officer - Foster Wheeler Environmental Corporation
RAC II program Manager - Foster Wheeler Environmental Corporation
RAC II Quality Assurance/Data Quality Manager - Foster Wheeler Environmental Corporation
Work Assignment Manager - United States Environmental Protection Agency
QA Officer - United States Environmental Protection Agency

1.0 INTRODUCTION

A remedial investigation and feasibility study (RI/FS) of the Cornell-Dubilier Electronics Superfund Site (the Site), Middlesex County, New Jersey will be conducted by Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) in accordance with the Statement of Work (SOW) included as Attachment 1 to the Work Assignment Form (WAF) issued by the United States Environmental Protection Agency (USEPA) on March 31, 1999. In addition, all RI/FS activities will be based upon and consistent with USEPA guidance, including those documents listed in Section 5.

The primary objectives of this RI/FS will be to:

- Characterize the nature and extent of contamination on the Site;
- Characterize the migration of contaminants and determine the impacts to off-site locations;
- Determine the current and potential future human health and ecological risks on the Site, and within the Bound Brook drainage basin downstream of the Site; and,
- Determine the most appropriate remedial alternatives to minimize continued risks to human health and/or the environment.

This RI/FS Work Plan, which describes investigative activities designed to achieve the above objectives, has been prepared by Foster Wheeler Environmental in response to Work Assignment 018-RICO-02GZ (USEPA; March 31, 1999), issued under USEPA RAC II Contract Number 68-W-98-214. Section 1 consists of this general introduction, a statement of the purpose of the RI/FS, and an overview of the Site background, including brief summaries of the Site description and history. Section 2 presents the current state of knowledge of Site-related contamination. Section 3 discusses Tasks 1 through 16 of the RI/FS. These tasks reflect those presented in the SOW issued as Attachment 1 of the WAF (USEPA; March 31, 1999) and revised by the USEPA following the Scoping Meeting on June 23, 1999 (see Section 3.1.3). This Work Plan also takes into account various background documents provided by the USEPA; discussions with the USEPA Work Assignment Manager (WAM) and technical staff during the May 18, 1999 site visit and June 23, 1999 scoping/technical meeting; and the RAC II SOW Work Breakdown Structure. The revised WAF was issued on June 25, 1999. Section 4 presents Foster Wheeler Environmental's project management approach and proposed project schedule, and Section 5 lists applicable references.

A Field Operations Plan (FOP); which consists of a Field Sampling Plan (FSP), Site Management Plan (SMP), Quality Assurance Project Plan (QAPP) and Environmental Health and Safety Plan (EHS Plan) is included with this Work Plan as Appendix A. The Optional Form 60, which contains an estimate of the labor effort and a proposed budget for Tasks 1 through 16, is submitted under separate cover.

1.1 PURPOSE

One of the purposes of this work assignment is to collect sufficient environmental data to develop a conceptual model for the Site that will define:

- The source or sources of contamination on the Site;
- The pathways, mechanisms and rates of contaminant migration through environmental media on- and off-site; and
- The concentrations of contaminants at points of exposure to human and ecological receptors.

The point-of-exposure concentrations, whether modeled or measured directly, will then be used to assess human health and ecological risks associated with current and potential future uses of the Cornell-Dubilier Site, adjacent residential and commercial properties, and downstream reaches of the Bound Brook. The results of the risk assessment will be used in conjunction with the conceptual model and any requisite treatability study results to select a remedy to eliminate, reduce, or control unacceptable risks to human health or the environment.

Existing data will be used to the maximum extent practicable to support this RI/FS. As stated in the USEPA SOW, the goal is to develop the minimum amount of additional data to support selection of an appropriate remedial alternative and develop a well-supported Record of Decision (ROD).

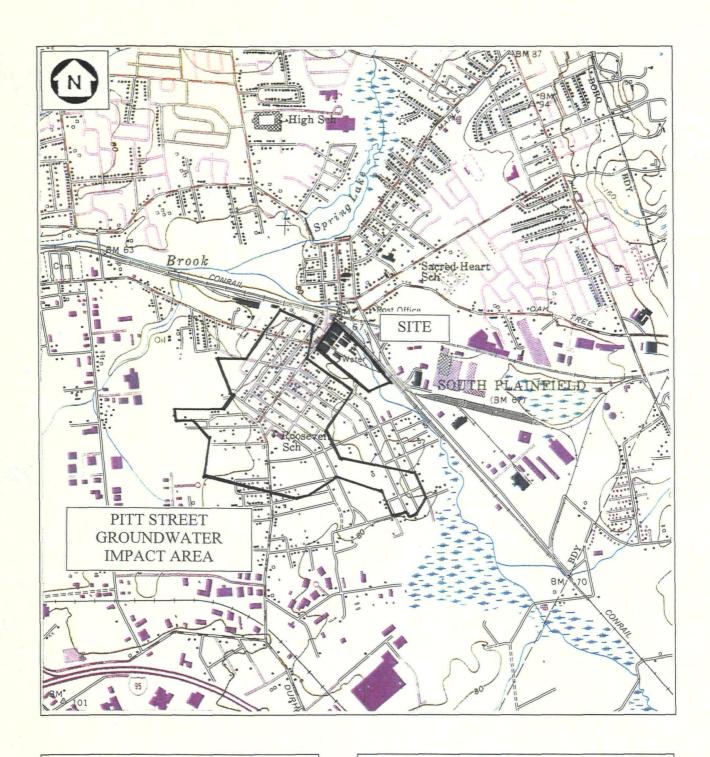
1.2 BACKGROUND

The information presented in the sections that follow has been summarized from USEPA, 1996, 1999a; USGS, 1943, 1968; Middlesex Water Company, 1999.

1.2.1 <u>Site Location and Description</u>

The Cornell-Dubilier Site consists of a 25-acre property located at 333 Hamilton Boulevard in South Plainfield, Middlesex County, New Jersey (see Figure 1-1). Cornell-Dubilier Electronics Corporation, Inc. (Cornell-Dubilier) manufactured electronic components, including capacitors, at the Site from 1936 to 1962. The Site is currently occupied by the Hamilton Industrial Park, which consists of approximately 15 small industrial operations. Figure 1-2 shows the general layout of the Site, which is bordered on the northeast by the Bound Brook and the Lehigh Valley Railroad, Perth Amboy Branch; to the southeast by the South Plainfield Department of Public Works property, which includes an unnamed tributary to the Bound Brook; to the southwest, across Spicer Avenue, by single-family residential properties; and to the northwest, across Hamilton Boulevard, by mixed residential and commercial properties. Note that Factory Street and Kenneth Avenue, which are shown in Figure 1-2, are not completed streets, but are rights of way, or "paper streets," that lie within the Department of Public Works property.

The Hamilton Industrial Park is located in the western portion of the Site, which is largely paved or occupied by buildings. All areas used as driveways, parking areas and walkways were paved by the property owner pursuant to an administrative order issued by the United States Environmental Protection Agency in March 1997. Site control measures including the installation of a six-foot chain link fence, posting of warning signs, and implementing engineering controls to limit the migration of contaminants through surface water run-off were also instituted pursuant to this order. This area is gently sloping, with elevations ranging from approximately 71 to 81 feet above mean sea level (msl). The central portion of the Site is primarily an open field, with some wooded areas to the south and a paved area (former truck driving school) in the center. This area is relatively level, with elevations ranging from approximately 72 to 75 feet above msl. The Site drops steeply to the east, and the eastern portion of the Site consists primarily of a wetland area bordering the Bound Brook.



<u>SOURCE</u>: US Geological Survey 7.5-minute topographic map for Plainfield, New Jersey.

SCALE: 1: 24 000

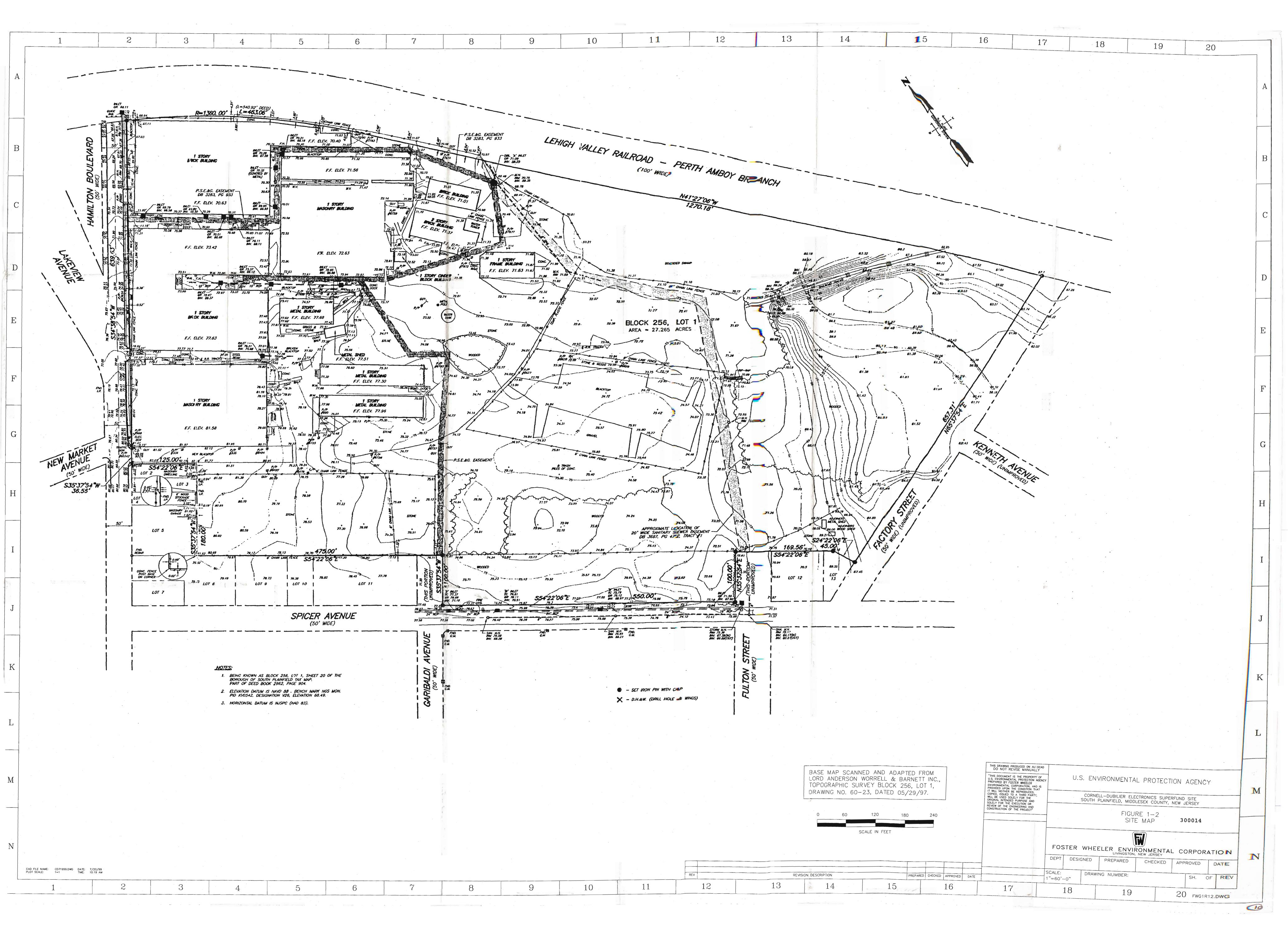
US ENVIRONMENTAL PROTECTION AGENCY CORNELL-DUBILIER ELECTRONICS

ELL-DUBILIER ELECTRONICS
SUPERFUND SITE

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, MIDDLESEX COUNTY, NEW JERSEY

> FIGURE 1-1 SITE LOCATION MAP

FOSTER WHEELER ENVIRONMENTAL CORPORATION



Elevations in this area range from approximately 72 feet above msl at the top of the bank to approximately 60 feet above msl along the Bound Brook.

1.2.2 Site History

Cornell-Dubilier manufactured electronics components at the Site from 1936 through 1962. Polychlorinated biphenyls (PCBs) and chlorinated organic degreasing solvents were used in the manufacturing process, and it has been alleged that during Cornell-Dubilier's period of operation, the company disposed of PCB-contaminated materials and other hazardous substances at the Site. A former employee has claimed that the rear of the property was saturated with transformer oils and that transformers were also buried behind the facility during the same time period.

New Jersey Department of Environmental Protection (NJDEP) personnel visited the Site on March 12, 1985, and noted that a portion of the lot located in the back of the facility contained a black soil unnatural to the area. In 1988, a response letter was delivered to the NJDEP by a law firm representing Cornell-Dubilier, which indicated that small accidental leaks or spills of PCBs occurred at the Site and that chlorinated organic solvents were used during processes conducted at the Site. Trichloroethylene (TCE) was the degreasing agent admitted to be used. The Cornell-Dubilier response letter also indicated that residual wastes from on-site processes may have been landfilled on the Site property. NJDEP personnel noted that four large black tanks were present on the edge of a large filled-in area near the rear of the Site. The tanks were at the top of an embankment leading down to the Bound Brook. Five tanks were observed in this area during a USEPA On-Site Reconnaissance visit conducted on March 30, 1994 and again during a USEPA Site Inspection Prioritization (SIP) sampling event conducted on June 8, 1994. The five tanks were removed from the Site prior to the Hazard Ranking System (HRS) sampling event conducted on February 29, 1996.

The following is a brief chronological summary of the sampling and analytical programs conducted on or in the vicinity of the Cornell-Dubilier Site to date. A more detailed discussion of the current understanding of Site-related contaminants is presented in Section 2.0.

- September 11, 1986 NJDEP conducted a Site Inspection and collected surface soil, surface water, and sediment samples at the Site. Exact sample locations are not available. Several metals, volatile organic compounds (VOCs), and a PCB were detected in the soil and sediment samples.
- June 8, 1994 USEPA collected surface soil, sediment and surface water samples from the Site. Aroclor 1254, a PCB, and various inorganic constituents (i.e., metals) were detected in soils at concentrations significantly exceeding background levels. Aroclor 1254, TCE and lead were detected in a sediment sample from the Bound Brook near the rear of the property. Aroclor 1254, Aroclor 1248, TCE and various inorganics were also detected in surface water samples from the Bound Brook at concentrations significantly exceeding background levels.
- October 13, 1994 USEPA collected two additional sediment samples from an unnamed tributary to the Bound Brook.
- June 11, 1996 USEPA completed a screening-level ecological risk assessment, which included a comparison of surface water and sediment contaminant levels to available

screening values. The risk assessment indicated that contamination of stream sediments adjacent to, and apparently associated with, the Site were present at levels that have been linked to adverse impacts in benthic organisms in other freshwater systems.

- June 27 and 29, 1996 USEPA collected surface and subsurface soil samples from a roadway, a vacant field, and a foot/bicycle path on the Site. Aroclor 1254 was detected in surface soils at concentrations as high as 51,000 mg/kg and at 100 mg/kg in a sample from the floodplain of Bound Brook. Concentrations of Aroclor 1254 ranged up to 3,000 mg/kg along the foot/bike path. Lead was detected on the surface of the Site roadway at concentrations as high as 340 mg/kg, and beneath the stone/gravel layer at concentrations as high as 7,460 mg/kg. Lead concentrations ranging from 1,740 mg/kg to 66,600 mg/kg were measured in surface soil samples collected near the foot/bicycle path and the northeast corner of the fenced area, within the area where exposed waste materials were located.
- July 16, 1996 Test pits were excavated in the vacant field and additional soil samples were collected. The test pits revealed stained subsurface soils, drum carcasses, electrical parts, mica-like chips, wood and debris. Aroclor 1254 and lead were detected at concentrations as high as 1,900 mg/kg and 1,970 mg/kg, respectively.
- February 29, 1996 USEPA collected additional soil samples and sediment samples from the unnamed tributary to the Bound Brook.
- March 21, 1997 USEPA conducted wipe sampling in 12 buildings located at the Site, identifying Aroclor 1254, Aroclor 1260, lead and cadmium contamination on building surfaces.
- June 9, 1997 USEPA conducted chip and vacuum sampling of two building interiors at the Site. Concentrations of Aroclor 1248 and Aroclor 1254 as high as 21,000 mg/kg and 57,000 mg/kg, respectively, were measured in the chip samples.
- June 1997 USEPA initiated a study to determine the impacts of contamination of the Bound Brook to human health and the environment. Soil, sediment, water, and biota (fish, crayfish and small mammals) samples were collected along the Bound Brook adjacent to and downgradient of the Site. Samples of edible fish were collected from the Bound Brook, New Market Pond, and Spring Lake for use in assessing human health risks.
- June 26 and 27, 1997 USEPA collected 23 surface soil samples from residential properties adjacent to the Site.
- August 1997 USEPA collected soil, sediment, water and biota samples along the Bound Brook adjacent to and downstream of the Site. Aroclor 1254 concentrations as high as 13 mg/kg and 6.2 mg/kg were measured in the sediment and floodplain soils, respectively. PCBs, metals and pesticides were detected in fish fillet samples.
- October 1997 USEPA collected surface soil samples at residential properties located on Spicer Avenue, southwest of the Site. Aroclor 1254 and Aroclor 1260 concentrations as high as 22 mg/kg and 2.2 mg/kg, respectively, were measured in these "Tier I" soil samples.

- November 1997 USEPA collected interior dust samples at residential properties located along Spicer Avenue. Aroclor 1254 and Aroclor 1260 concentrations as high as 120 mg/kg and 85 mg/kg, respectively, were measured in the dust samples.
- April 20, 1998 USEPA conducted additional "Tier II" soil sampling at residential properties adjacent to the Site.
- April 21 through 28, 1998 USEPA conducted sampling of residential interiors for PCBs at thirty-six residences.
- May 4 and 5, 1998 USEPA conducted additional "Tier III" soil sampling at residential properties adjacent to the Site.
- August 14 through November 1998 USEPA conducted sampling along the Bound Brook floodplain.
- October 26 and 27, 1998, USEPA collected indoor wipe samples at 13 businesses located adjacent to the Site.
- October 1998 USEPA collected one to two surface soil samples from five of the 13 commercial properties where soil was available for sampling.
- October 1998 USEPA collected indoor dust samples from five residential properties.
- November 14, 1998 USEPA collected approximately 33 surface soil samples from Property FF located on Spicer Avenue (referred to as Addendum to Tier I).
- November 21, 1998 USEPA resampled soils at the following locations: CCSD1 (Transect CC), DDSS1 (Transect DD), HHSD1 (Transect HH), PPPND2 (Transect PPP) and UUUSD1 (Transect UUU). One surface soil sample and four subsurface soil samples were collected and analyzed for total PCBs.
- April 20 and 21, 1999 NJDEP, Environmental Measurements and Site Assessment Section (EMSA) conducted sediment sampling in Spring Lake and along Cedar Brook from Plainfield High School to the lake. Sediment samples were also collected along a feeder stream from Maple Avenue to Cedar Brook. No PCBs were detected in any of the samples collected. Alpha- and gamma-chlordane were the most prevalent contaminants detected, with concentrations as high as 0.17 ppm and 0.13 ppm, respectively. DDT and DDD were also listed as primary contaminants, with concentrations as high as 0.69 ppm and 0.091 ppm, respectively.
- June 21 to 23, 1999 USEPA collected additional samples from Reach 5 and Reach 6 of the Bound Brook floodplain, downstream of Spring Lake. Four areas were sampled: Area 1 (Veteran's Memorial Park), Area 2 (north side of Cedar Brook, between Lowden and Oakmoor Avenues), Area 3 (north side of Bound Brook in the vicinity of Fred Allen Drive)

and Area 4 (located adjacent to stream 14-14-2-3 as identified on the Flood Insurance Map for the Township of Piscataway, south of New Market Avenue and east of Highland Avenue). All samples were analyzed for total PCBs. Area 1 samples had concentrations ranging from non-detect to 25 ppm, Area 2 samples had concentrations ranging from 2.5 ppm to 7.5 ppm, and Area 4 samples had concentrations ranging from non-detect to 0.21 ppm.

• June 4, 23 and July 28, 29 1999 - Environ Corporation, on behalf of Foley Hoag & Elliot, LLP Mintz, Levin, Cohn, Ferris, Glovsky & Popeo, P.C., who represent DSC of Newark Enterprises, Inc.; conducted a preliminary evaluation of ground water conditions at the Site (Preliminary Ground Water Assessment Report for the Hamilton Industrial Park Site; Environ, October 1999). Bedrock was encountered at depths of 6 to 13 feet below ground surface. Permanent ground water was present only in the bedrock at depths greater than 25 feet. TCE and 1,2-DCE were detected at concentrations as high as 29,000 ug/L and 14,000 ug/L, respectively. Aroclor 1254 and Aroclor 1242 were detected at concentrations as high as 14 ug/L and 130 ug/L, respectively.

The overall results of USEPA's sampling and analyses indicate elevated concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs and inorganic constituents in the Site soils. Building interiors at the Site were found to contain elevated PCBs and metals. Off-site investigations at residential properties identified the presence of PCBs in soils and in-house dust at several residences near the Site. Fish collected from the Bound Brook were found to contain PCBs at concentrations higher than allowed by the Food and Drug Administration.

To date, the following actions have been taken to reduce the potential for exposure to on-site contaminants and limit the off-site migration of contaminants:

- March 25, 1997 A unilateral administrative order was issued to the current owner of the Hamilton Industrial Park, D.S.C. of Newark Inc., which required that a removal action be taken to stabilize the Site. The scope of work included paving facility driveways and parking areas, installing security fencing and warning signs to limit access to the Site, and installing silt fencing to limit off-site migration of surface soils.
- August 8, 1997 NJDEP issued an interim fish consumption advisory for the Bound Brook and New Market Pond.
- *March 29, 1998* USEPA initiated a removal action to clean the interiors of homes where PCBs were found in indoor dust at levels of potential health concern.
- August 1998 Cornell-Dubilier Electronics and D.S.C. of Newark, Inc. entered into an Administrative Consent Order for a removal action which included removal and disposal of contaminated soil from certain residential properties.
- *March 1999* USEPA ordered Cornell-Dubilier Electronics and D.S.C. of Newark, Inc. to conduct a removal action at seven additional residential properties.

1.2.3 Site Geology and Hydrogeology

The Cornell-Dubilier Site lies within the Piedmont Physiographic Province, which is underlain by the Triassic-Age Brunswick Shale Formation of the Newark Group. In the immediate vicinity of the Site, the Brunswick Shale is overlain by both Quaternary and Pre-Quaternary glacial deposits. The Quaternary deposits can be further classified into alluvial deposits and Wisconsin Drift.

The Wisconsin Drift was deposited by a continental ice sheet that covered portions of the northern United States and is comprised of stratified drift, terminal moraine and a till plain, each of which occur within four miles of the Site. The southern limit reached by the Wisconsin ice sheet lies roughly along a curved line from Plainfield to Metuchen and the mouth of the Raritan River at Perth Amboy. The Site is located within the boundaries of the outwash plain, an area of approximately 16 square miles located between Metuchen, Plainfield and East Bound Brook. The outwash plain consists of layers of sand and gravel which together are designated as stratified drift. This deposit is approximately 10 to 60 feet thick on its eastern edge and becomes finer and thinner to the west. The estimated average hydraulic conductivity of the Wisconsin Drift is approximately 10^4 centimeters per second (cm/s) (USEPA, 1996).

The terminal moraine deposits are located within two miles of the Site to the northeast and are composed of a mixture of red clay, sand, gravel and a few boulders. A few localities include beds of stratified permeable material that yield significant amounts of water. However, in most areas the terminal moraine is relatively impermeable, with an average hydraulic conductivity of approximately 10^{-6} cm/s, and does not yield significant quantities of groundwater (USEPA, 1996). The thickness of the moraine ranges from approximately 80 to 150 feet.

A till plain that is similar in composition to the terminal moraine outcrops approximately four miles northeast of the Site. The average thickness of the till ranges from 20 to 30 feet, with a maximum thickness of approximately 80 feet. This till plain is not used as a major source of groundwater.

Alluvial deposits are likely to be found along the banks of the Bound Brook. This alluvium is relatively impermeable, and is of no significant importance as a groundwater supply.

Relatively little information is available concerning the Pre-Quaternary deposits that outcrop south of the Site. However, all of the drinking water supply wells within four miles of the Site are located north of the Site and are screened within the Wisconsin Drift or the underlying Brunswick Shale Formation.

The Brunswick Formation is a dull red shale interbedded with siltstones and occasional layers of sandstone. The sedimentary rocks of the Brunswick Formation dip to the northwest at angles of 5 to 15 degrees. Fractures within this formation intersect at many angles, with the result that groundwater may generally move in any direction. Groundwater flow direction is thus generally controlled by potentiometric conditions.

Information from the United States Geological Survey (USGS) [Special Report No. 27, 1968] for the Westfield area, which is several miles to the northeast of the Site, indicates approximately 75 feet of unconsolidated deposits overlying the Brunswick Formation. Boring logs obtained from the

Middlesex Water Company for the Park Avenue Wellfield, which is located approximately one-half mile north-northeast of the Site (roughly along the strike of the Brunswick Formation), indicate an average depth to bedrock of approximately 64 feet. However, a recent groundwater investigation conducted on behalf of the current property owner, DSC of Newark Enterprises, Inc. (*Preliminary Ground Water Assessment Report for the Hamilton Industrial Park Site*; Environ Corporation, October 1999) identified weathered bedrock at depths ranging from 6 to 13 feet below the ground surface (bgs) at the Site. An exploratory hollow stem auger boring met refusal at a depth of 24.5 feet without encountering groundwater. Subsequent boreholes drilled into the competent bedrock using air rotary methods first encountered groundwater at depths of 50 to 55 feet bgs. Therefore, a reasonable estimate for the depth to the competent bedrock surface beneath the Site is 20 to 30 feet bgs, with an estimated depth to groundwater filled fractures of approximately 50 to 55 feet bgs. The potentiometric surface was between 20 and 30 feet bgs. Permanently saturated conditions are not expected in the unconsolidated overburden.

Groundwater was encountered in test pits excavated on July 16, 1996 at depths ranging from 4.5 feet to 9 feet below the ground surface. However, given the available information regarding hydrogeological conditions at the Site, it is likely that the water observed in these test pits represents localized, potentially transient, perched aquifer conditions.

Tech\RAC\Cornell Dub\WP.wpd

2.0 SUMMARY OF SITE CONTAMINATION

The summary of Site contamination presented in the following subsections is based on data presented in the following documents: USEPA, 1999; USEPA 1996; USEPA, 1999a; NJDEP, 1991; GTI, 1994; Weston, 1998; Weston, 1998a; Weston, 1998b; Weston, 1998c; Weston, 1998d; Weston, 1998e; and Weston, 1998f.

2.1 SUMMARY OF DETECTED CONTAMINANTS

Investigatory activities undertaken by NJDEP, USEPA and/or DSC of Newark Enterprises, Inc. have occurred at the Site or in the vicinity of the Site since 1986. Soil, sediment, surface water, biota, air, wipe, chip, and dust samples have been collected from the Site. Sampling events in the vicinity of the Site have occurred for groundwater, soil, wipe, and dust.

Known contaminants present in samples collected from the Site proper include VOCs, SVOCs, pesticides, PCBs, and several metals, as follows:

Volatile Organics	Semi-Volatile Organics	Pesticides/PCBs	Metals
1,2-Dichloroethene	Phenanthrene	Aroclor-1016	Arsenic
Trichloroethene	Anthracene	Aroclor-1248	Barium
	Fluoranthene	Aroclor-1254	Cadmium
	Pyrene	Aroclor-1260	Chromium
	Benzo(a)anthracene	4,4'-DDE	Copper
	Chrysene	4,4'-DDD	Lead
	Benzo(b)fluoranthene	alpha-Chlordane	Mercury
	Benzo(k)fluoranthene	gamma-Chlordane	Silver
	Benzo(a)pyrene	Endrin aldehyde	Zinc
	Indeno(1,2,3-cd)pyrene	Heptachlor epoxide	
	Dibenz(a,h)anthracene	Methoxychlor	
	Benzo(g,h,i)perylene	·	

Known contaminants present in samples collected in the vicinity of the Site include VOCs and PCBs, as follows:

Volatile Organics	<u>PCBs</u>
Trichloroethene	Aroclor-1242
Tetrachloroethene	Aroclor-1254
	Aroclor-1260

Among these chemical constituents, PCBs (especially Aroclor-1254) were identified as being of the most concern in prior investigations. A summary of chemical constituents detected in surface and subsurface soil; sediment and surface water; biota; building wipe, chip, air and dust; and, groundwater are presented in the subsections that follow.

2.2 SURFACE AND SUBSURFACE SOIL CONTAMINATION

Maximum concentrations of the chemical constituents identified in the surface and subsurface soils at the Site are as follows:

	Maximum Soil
<u>Constituent</u>	Concentration (mg/kg)
1,2-Dichloroethene	0.019
Trichloroethene	0.082
Phenanthrene	2.2
Anthracene	0.38
Fluoranthene	5
Pyrene	2.9
Benzo(a)anthracene	1.8
Chrysene	2.3
Benzo(b)fluoranthene	2.5
Benzo(k)fluoranthene	1.6
Benzo(a)pyrene	1.9
Indeno(1,2,3-cd)pyrene	1.4
Dibenz(a,h)anthracene	0.46
Benzo(g,h,i)perylene	1.1
Aroclor-1254	51,000
Arsenic	25.7
Barium	350
Cadmium	373
Chromium	78.6
Copper	3,020
Lead	66,600
Mercury	2.9
Silver	26.7
Zinc	1,380

PCB compounds were detected in samples from the open area in the middle portion of the Site (as high as 51,000 mg/kg near the northeast corner of the fenced area); along the foot/bike path (as high as 3,000 mg/kg); from the floodplain area in the eastern portion of the Site (as high as 100 mg/kg); from the surface of the roadway (as high as 340 mg/kg); and, from the soils below the roadway stone/gravel layer (as high as 22,000 mg/kg).

Soils along the downstream portion of the Bound Brook were sampled depths between 0 and 2 feet bgs. The soils contained total PCBs up to 830 mg/kg.

Off-site surface soils were sampled from residences in the vicinity of the Site during three separate events. Analyses indicated Aroclor-1254 and Aroclor-1260 at concentrations ranging from 2.9 mg/kg to 60 mg/kg and from 0.75 mg/kg to 4.6 mg/kg, respectively.

2.3 SEDIMENT AND SURFACE WATER CONTAMINATION

Samples of sediment and surface water from Bound Brook adjacent to and downstream of the Site have been collected. Additional sediment samples were collected along the Bound Brook corridor as far downstream as New Market Pond, approximately 2 miles from the Site. Maximum constituent concentrations are as follows:

	Maximum Sediment	Maximum Surface Water
Constituent	Concentration (mg/kg)	Concentration (ug/L)
1,2-Dichloroethene	0.051	100
Trichloroethene	0.12	2
Chrysene	5.1	
Indeno(1,2,3-cd)pyrene	4.7	
Dibenz(a,h)anthracene	2.2	
Benzo(g,h,i)perylene	4.5	
Aroclor-1248		24
Aroclor-1254	550	20
Arsenic		15.6
Barium	380	
Cadmium	24.8	14.5
Chromium		25.7
Copper	210	90
Lead	552	180
Mercury		0.23
Silver		3.8
Zinc	610	994

2.4 BIOTA CONTAMINATION

Biota samples were collected from Bound Brook adjacent to and downgradient of the Site. Analysis of fillet samples from all analyzed species (carp, white sucker, pumpkin seed, and large mouth bass) indicated detectable levels of PCBs. Seven pesticides were also detected. The following presents the maximum concentrations for the biota samples:

2-3

	Maximum Biota Concentration
Constituent	(ug/kg wet weight)
4,4'-DDE	310
4,4'-DDD	230
alpha-Chlordane	310
gamma-Chlordane	230
Endrin aldehyde	110
Heptachlor epoxide	110
Methoxychlor	4
Aroclor-1248	10,000
Aroclor-1254	26,000

2.5 BUILDING WIPE, CHIP, AIR, AND DUST CONTAMINATION

The on-site buildings have been sampled for PCBs and/or selected metals by wipe, chip, air, and dust sampling, and maximum concentrations are as follows:

Constituent	Maximum Wipe Concentration (ug/100 cm²)	Maximum Chip Concentration (mg/kg)	Maximum Air Concentration (ug/m³)	Maximum Dust Concentration (mg/kg)
Aroclor-1016			33	
Aroclor-1248		21,000	12	5,200
Aroclor-1254	500	57,000	, 	16,000
Aroclor-1260	180			
Cadmium	34	 ·	0.054	130
Lead	780		0.971	3,800

Interior dust has also been sampled at nearby residential properties, and analysis indicated detectable levels of three PCBs: Aroclor-1248, Aroclor-1254 and Aroclor-1260. The maximum residential dust sample concentration was 205 mg/kg. Wipe sampling conducted at nearby businesses found no detectable levels of PCBs.

2.6 GROUNDWATER

Groundwater beneath the Site was collected from temporary monitoring wells on behalf of the property owner, DSC of Newark Enterprises, Inc. Maximum concentrations of the chemical constituents identified in the groundwater beneath the Site are as follows:

	Maximum Groundwater
Constituent	Concentration (ug/L)
1,2-Dichloroethene	14,000
Acetone	3.1J
Benzene	0.79J
Chlorobenzene	11
Tetrachloroethene	32
Trichloroethene	29,000
Aroclor-1242	130
Aroclor-1254	14

Off-site groundwater quality has been sampled by NJDEP. Trichloroethene (up to 6,850 ug/L) and tetrachlorethene (up to 12.6 ug/L) have been detected in private wells near the Site, and areas to the south and west of the Site have been designated an "Interim Ground Water Impact Area" due to chlorinated VOC contamination (see Figure 1-1).

3.0 TASK PLAN FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY

This section discusses Tasks 1 through 16 of the RI/FS. The tasks detailed below reflect those presented in the SOW issued as Attachment 1 of the WAF (USEPA; March 31, 1999) and revised by the USEPA following the Scoping Meeting on June 23, 1999. This Work Plan also takes into account various background documents provided by the USEPA; discussions with the USEPA Work Assignment Manager (WAM) and technical staff during the May 18, 1999 Site visit and June 23, 1999 scoping/technical meeting; and the RAC II SOW Work Breakdown Structure.

Task 1	Project Planning and Support
Task 2	Community Relations
Task 3	Field Investigation
Task 4	Sample Analysis
Task 5	Analytical Support and Data Validation
Task 6	Data Evaluation
Task 7	Assessment of Risk
Task 8	Treatability Study & Pilot Testing
Task 9	Remedial Investigation Report
Task 10	Remedial Alternatives Screening
Task 11	Remedial Alternatives Evaluation
Task 12	Feasibility Study Report
Task 13	Post RI/FS Support
Task 14	Negotiation Support
Task 15	Administrative Record
Task 16	Work Assignment Closeout

A more detailed description of each task is presented in the following sections.

3.1 TASK 1 - PROJECT PLANNING AND SUPPORT

The project planning task includes the efforts for execution and overall management of all required tasks within the SOW. Technical and management activities required to perform the investigatory and risk assessment activities, along with associated costs, have been developed during the planning phase and are presented in this Work Plan. Activities required for general work assignment management, including preparation of monthly progress reports and invoices, that will occur throughout the duration of the project are also included in this task. Specifically, Foster Wheeler Environmental will perform the activities detailed in the following subsections.

3.1.1 Project Administration

Project administration support executed during the performance of this work assignment as part of Task 1 includes both RAC II Program Support and project-specific management activities.

RAC II Program support for this Work Assignment will include review of the Work Assignment budget and Work Assignment Technical/Financial Status Reports for the Monthly Progress Report, technical resource management, response to questions from the USEPA Project Officer/Contract

Officer (PO/CO), and monthly invoice preparation. All of these activities will be performed by Program Support personnel.

Project-specific management will be provided by the Foster Wheeler Environmental Project Manager and will include resource management; preparation of the technical monthly progress report; coordination of all field investigative, data evaluation and report preparation efforts; review and updating of the project's schedule and weekly financial reports; weekly (at a minimum) communication with the USEPA WAM; and attendance at quarterly internal RAC II Project Manager meetings.

3.1.2 Conduct Site Visit

An on-site visit was conducted by USEPA and Foster Wheeler Environmental personnel on May 18, 1999, at which time preliminary technical/logistical issues were discussed with the USEPA WAM. Additional, more detailed discussions of these issues were conducted during the scoping and technical meetings on June 23, 1999.

3.1.3 Attend Scoping Meeting

A scoping meeting was held between USEPA and Foster Wheeler Environmental on June 23, 1999, at which time the SOW was discussed. This meeting focused solely upon the contractual scope of the RI/FS work assignment. Immediately following the scoping meeting, a technical meeting was held between USEPA and Foster Wheeler Environmental technical personnel to discuss investigative strategies for the Site. Minutes summarizing the scoping and technical meetings were prepared and submitted to the USEPA on June 25, 1999 and June 28, 1999, respectively.

These meetings resulted in agreement that two separate phases of environmental sampling would be necessary, resulting in a total of three separate mobilizations and three separate demobilizations (one for the site reconnaissance and one for each phase of environmental sampling). Agreement was also reached on minor wording changes to deliverable due dates. Discussions of investigative strategies then focused on taking advantage of the multi-phase approach to design a cost-effective sampling and analysis program.

The general approach discussed was for the reconnaissance event to consist primarily of non-intrusive investigation methods (e.g., wetland delineation/characterization, land/building survey, geophysical survey, soil gas survey) focused on clarifying the working hypotheses for the Site, and to determine and mark precise sampling locations. Intrusive methods that will be conducted during the reconnaissance phase include excavation of test pits to define the boundaries of a dump/fill area, and sampling of surface soils on residential and commercial properties adjacent to the Site. It was also agreed that the sampling density for the residential and commercial properties should be consistent with previous sampling efforts by the USEPA of properties along Spicer Avenue (i.e., a total of 20 samples were collected on each residential property). Therefore, additional soil samples will be collected on each residential property that has had only one sample collected with a total PCB concentration greater than 0.49 milligrams per kilogram (mg/kg) to bring the total number of samples to 20.

3.1.4 Develop Draft Work Plan and Associated Cost Estimate

This RI/FS Work Plan has been developed to specify the investigative activities that will be performed by Foster Wheeler Environmental during the performance of this RI/FS. The Work Plan is based upon the SOW issued as Attachment 1 of the WAF (USEPA; March 31, 1999) and revised by the USEPA following the Scoping Meeting on June 23, 1999. This Work Plan also takes into account various background documents provided by the USEPA; discussions with the USEPA Work Assignment Manager (WAM) and technical staff during the May 18, 1999 site visit and June 23, 1999 scoping/technical meeting; and the RAC II SOW Work Breakdown Structure. Included as Appendix A to this Work Plan is the Field Operations Plan (FOP), which consists of a Field Sampling Plan (FSP), Site Management Plan (SMP), Quality Assurance Project Plan (QAPP) and Environmental Health and Safety Plan (EHS Plan). The Optional Form 60 has been submitted under separate cover.

The Optional Form 60 provides the estimated cost to complete the work for Tasks 1 through 16, as indicated in the SOW, and is broken down into Level-of-Effort (LOE), by "P-level," and cost for each element of work described herein.

3.1.5 Negotiate and Revise Draft Work Plan

Foster Wheeler Environmental and USEPA will participate in a Work Plan negotiation meeting at a date yet to be determined, either at USEPA Region II facilities or via tele-conference, to discuss and agree upon the estimated cost required to accomplish the tasks outlined in this Work Plan. Any agreements reached during the negotiation meeting will be provided to the USEPA in the form of a revised budget, and a Final Work Plan.

3.1.6 Evaluate Existing Data and Documents

A review of various Site background documents provided by the USEPA WAM has been performed during the preparation of this Work Plan. Available historical fire insurance maps (e.g., Sanborn maps) for the Site and immediate vicinity will also be reviewed prior to conducting the Site Reconnaissance to provide additional information about historical features and uses of the Site. These maps will be purchased, along with a report summarizing the results of an environmental records search for the area, from Environmental Data Resources, Inc. (EDR).

Foster Wheeler Environmental will review site files maintained by the New Jersey State Museum and the Historic Preservation Office to determine if there are any previously recorded archeological or architectural resources that are nominated to, eligible for, or listed in the National Register of Historic Places, located within the project area or its immediate vicinity. Considered in conjunction with other available information about previous site disturbance, these data will be used to assess the potential for the project to affect historic properties (e.g. cultural resources that meet the criteria for eligibility to the National Register of Historic Places). If USEPA determines that the National Historic Preservation Act (NHPA) is an ARAR for this Site, then this information will be incorporated into a full Stage 1A report as part of the Phase II RI. If the project area proves to have a high potential to contain historic properties that may be affected by the project, then further cultural resources investigations (e.g., Stage 1B, Stage II, and possibly Stage III) may also be recommended.

These may include more extensive literature reviews to substantiate documentation of previous ground disturbance or could potentially include subsurface investigations of areas where future ground-disturbing activities will occur. If historic properties are documented that will be affected by the project, Foster Wheeler Environmental would be available to assist USEPA in developing a Memorandum of Agreement that will outline recommended mitigation to minimize affects to historic properties. In addition, Foster Wheeler Environmental would be available to assist USEPA in conducting Native American consultation and developing a plan for addressing potential unanticipated finds that may be revealed during future ground-disturbing activities at the Site. At USEPA's request, scopes and budgets could be provided for these activities.

Additional review is also required of documents related to the ecological risk assessment prepared by the USEPA for portions of the Bound Brook adjacent to and downstream of the Site. Once all data associated with this risk assessment have been received by Foster Wheeler Environmental, a comprehensive data useability assessment will be performed as part of Task 6 (see Section 3.6 - Data Evaluation). Foster Wheeler Environmental, in cooperation with the USEPA, will determine the extent to which these data satisfy the requirements of the current baseline ecological risk assessment, and will determine the additional data requirements (data gaps) to support the risk assessment. These data gaps will then be addressed by appropriately focusing on sampling and analyses during the Phase II investigation.

As part of the field investigation activities, a wetland and habitat delineation will be performed. Prior to a field investigation, wetlands within the Cornell-Dubilier Site and the Bound Brook Corridor will be identified through evaluation of USFWS NWI maps, New Jersey State freshwater wetland maps, the Soil Survey of Middlesex soil maps, and recent aerial photography. In addition to identifying wetlands prior to the field investigation, the flood hazard area, 100-year floodplain, and 500-year floodplain of the Bound Brook Corridor will be delineated through the evaluation of the NJDEP flood hazard maps for Bound Brook, and the FEMA flood insurance rate maps.

Existing information on state and federal threatened, endangered, and species of special concern will be reviewed as part of the field investigation activities. USEPA will initiate an informal Section 7 consultation with the USFWS and inform Foster Wheeler Environmental of the results.

3.1.7 Quality Assurance Project Plan

A Site-specific Quality Assurance Project Plan (QAPP) and accompanying Field Sampling Plan (FSP) and Site Management Plan (SMP), which are components of the overall Field Operations Plan (FOP) for the Site, has been prepared in accordance with EPA QA/R-5 (October 1998), the approved Foster Wheeler Environmental RAC II Program Generic Quality Assurance Plan (July 1999), and other USEPA Region II guidance and/or procedural requirements. These documents, provided in Appendix A, describe the project objectives and organization, functional activities, and quality assurance/quality control (QA/QC) protocols used to achieve the desired Data Quality Objectives (DQOs). The FOP and QAPP describe Foster Wheeler Environmental's field activities and protocols for the investigatory phase of the work, including:

- Sampling objectives;
- Sample chain-of-custody/documentation;

- Sample numbers, matrices, locations, collection frequencies and type of analyses;
- Sampling equipment and procedures;
- Sample handling, preservation, shipment and analyses;
- QA/QC protocols and criteria utilized, including data validation; and,
- A breakout of samples to be analyzed via the USEPA Contract Laboratory Program (CLP) and other non-Routine Analytical Services (non-RAS) providers.

Also included are justifications for any additional sample data needed and any required non-RAS sample analyses.

3.1.8 Health and Safety Plan

A Site-specific Environmental Health and Safety Plan (EHS Plan) has been prepared for Foster Wheeler Environmental's Site investigation activities. This EHS Plan, provided in Appendix A, has been prepared to provide adequate health and safety protection for field personnel engaged in field sampling or other activities conducted within the investigation area in accordance with 29 CFR 1910.120 (1)(1) and (1)(2), 40 CFR 300.150, and other applicable codes and guidelines. The EHS Plan is required for any activity conducted within the study area, including reconnaissance, surveying, and collection of environmental samples. The EHS Plan will be updated, as warranted, if new conditions or tasks arise during the performance of field investigation activities. A Field Change Request Form will be used to make any required modifications, based on Site-specific conditions, to the Site-specific EHS Plan.

3.1.9 Non-RAS Analyses

Non-Routine Analytical Services (non-RAS) will be provided to USEPA for the project in accordance with the approved Foster Wheeler Environmental RAC II Program Delivery of Analytical Services Plan (July, 1998). A brief summary of the Non-Routine Analytical Services Plan is provided as an attachment to the QAPP (Part C of the FOP) presented in Appendix A. These non-RAS analyses will include TAL metals in floor dust, PCBs in soil and floor dust, PCB congeners in soil and groundwater, low concentration PCBs in groundwater, geotechnical parameters in soil, haloacetic acids in groundwater, and water quality parameters in groundwater; via a subcontract laboratory.

3.1.10 Meetings

Foster Wheeler Environmental will attend progress/technical meetings during the course of the project. At these meetings, during which the USEPA will be informed of the current status and progress of the project, Foster Wheeler Environmental will provide technical briefings to the USEPA. For project planning purposes, it is assumed that twenty (20) progress/technical meetings will be held at USEPA Region II offices in New York City, with two (2) Foster Wheeler Environmental personnel, the Project Manager and an appropriate technical discipline lead (i.e., risk assessment, geology/hydrogeology), attending. Pursuant to the SOW, the meetings will be assumed to be four (4) hours in duration. In support of these meetings, Foster Wheeler Environmental will prepare short presentations of the work performed to date. These presentations may include agenda, handouts, figures or photographs, as warranted. The appropriate scope of the presentation for each meeting will be discussed with the USEPA WAM. After each meeting, the Foster Wheeler Project

Manager will prepare and submit to the USEPA WAM within five (5) calendar days a meeting minutes letter report, briefly summarizing the salient points/discussions/conclusions/agreements of the meeting.

3.1.11 Subcontract Procurement

Pursuant to the SOW, Foster Wheeler Environmental has assumed the procurement of eight subcontractors to support the required tasks in this work assignment. Foster Wheeler Environmental intends to procure the services of the following subcontractors:

- Field Mobilization Services
- Drilling Services
- Surveying Services
- Non-RAS Analytical Laboratory Services
- Investigation Derived Waste (IDW) Transportation and Disposal Services
- File Closeout Services (including microfiche archival of project documents)
- Clearing and Grubbing
- Soil Gas Survey

Subcontract procurement activities needed to provide these services shall be performed in accordance with Foster Wheeler Environmental's Government Procurement Procedures which are based on the Federal Acquisition Regulations (FARs) and are the basis of our Government approved purchasing system.

The acquisition process for each subcontract award will be discussed between the Foster Wheeler Environmental Project Manager and procurement representative, and a plan developed prior to the solicitation of each award. Solicitation recipients will be drawn either from our vendor database or a CBD announcement if our database yields an insufficient number of potential subcontract firms.

3.1.12 Perform Subcontract Management

Foster Wheeler Environmental will perform all necessary subcontract management activities during the course of this work assignment. These activities shall consist of, but are not solely limited to, the following:

- Monitoring of subcontractor progress
- Maintenance of subcontracting systems and records
- Issuing subcontract modifications (if warranted)
- Review and approval of subcontractor invoices

All on-site subcontractor activities will be monitored on a daily basis by the Foster Wheeler Environmental Field Operations Leader and Environmental and Safety Supervisor. Subcontractor activities performed off-site will be monitored by the Foster Wheeler Environmental Project Manager or his designee.

Any changes to a subcontractor's scope of work will be reported to Foster Wheeler Environmental procurement representatives so that a proper determination can be made as to the subcontractor's

entitlement and price. After an evaluation of the change by both Foster Wheeler Environmental technical and procurement personnel, and receipt of the USEPA Contracting Officer's consent (if required), a subcontract modification may then be issued to effect the change. A change of work will not be made without a prior determination of entitlement and price, and subcontract modification (if warranted).

All subcontractor invoices will be submitted to the Foster Wheeler Environmental procurement representative for review, approval and distribution to the Project Manager and others, as appropriate, for their approval. When all approvals are obtained, the invoice is submitted to the Foster Wheeler Environmental accounting department for payment.

3.1.13 Pathway Analysis Report

Foster Wheeler Environmental will prepare a Pathways Analysis Report (PAR) in accordance with OSWER Directive 9285.7-01D-1 dated December 17, 1997 entitled, "Risk Assessment Guidelines for Superfund Part D". The PAR will include: A Selection of Exposure Pathways, RAGS Part D Table 1; "Values Used for Daily Intake Calculations", RAGS Part D Table 4; a narrative description of the selection of COCs from the list of detected chemicals; a prioritized listing of the sources for the toxicity values to be used in the assessment; and a brief narrative description of the risk calculations. The PAR will be submitted to USEPA 30 days after the project scoping meeting.

3.2 TASK 2 - COMMUNITY RELATIONS

3.2.1 Community Interviews

IT Corporation (IT), a team subcontractor with Foster Wheeler Environmental will provide community relations support, and will review relevant background information provided by Foster Wheeler Environmental and USEPA, including appropriate Site location and Site lay-out maps. IT will assist the WAM and the USEPA Community Relations Coordinator (CRC) in identifying key community members, establishing an interview schedule, developing draft and final interview questions, and conducting the interviews with the appropriate government officials (federal, state, county, and township), environmental groups, local media, and any other appropriate individuals or groups, either in person or via telephone, to identify community concerns associated with the Remedial Investigation and Feasibility Study (RI/FS). A Community Relations Specialist from IT will accompany the WAM and CRC on one round of community interviews in the local area, anticipated to take place over approximately a three-day period. The results of these interviews will be summarized in the Community Relations Plan (CRP) discussed in the following subsection.

3.2.2 Community Relations Plan

A draft and final Community Relations Plan will be prepared, as follows:

<u>Draft CRP</u>: The Draft CRP will present an overview of the community's concerns and include the following elements: (1) site background, including location, description, and history; (2) community overview, including community profile, concerns, and involvement; (3) community involvement objectives and planned activities, including a schedule to accomplish these objectives; (4) a mailing

list of contacts and interested parties; (5) the names and addresses of the information repositories and public meeting facility locations; (6) a list of acronyms; and (7) a glossary. The Draft CRP will be submitted to USEPA within 21 days of the final community interview.

<u>Final CRP</u>: Foster Wheeler Environmental will submit a final CRP in accordance with USEPA comments, within 14 days of receiving those comments.

3.2.3 Public Meeting Support

Community relations support will be provided for four public meetings and six Site tours. The public meetings and Site tours will be held in the South Plainfield, New Jersey area. The meetings and Site tours will take place in the late afternoon or early evening.

The following work will be performed to support the public meetings:

- Provide support for meeting logistics, including the selection and reservation of a meeting place.
- Prepare meeting announcements (e.g., flyer or "Dear Resident" letter from the USEPA WAM) and affix mailing labels. Submit to USEPA for mailing to appropriate parties on the mailing list.
- Attend a "dry run" (i.e., practice session) with representatives from USEPA.
- Prepare and distribute tent cards, sign-in cards, and handouts (for estimating purposes, 150 pages of handouts per meeting is assumed).
- Prepare draft and final audio-visual materials, which for estimating purposes may be either 15 overhead transparencies or one multimedia projector presentation with 15 images.
- Arrange for room set-up and audio-visual equipment, which may include an overhead projector, microphones and loudspeaker, multimedia projector, screen, or easels.
- Reserve a court reporter for each of the public meetings. A full-page original and a "four on one" page copy, along with a 3.5 inch diskette of the transcripts will be provided to USEPA, with additional copies placed in the information repositories. The diskette will be provided in WordPerfect 8.0, or the most recent USEPA-approved word processing format.
- Attend the meeting.
- Prepare a draft and final meeting summary.

The following work will be performed to support the Site tours:

• Provide support for tour logistics. It is assumed that the tours will consist of small groups (less than 20 people) touring the Site on foot, and will not require the rental of tour vans or buses.

- Prepare tour announcements and affix mailing labels. Submit to USEPA for distribution to appropriate parties on the mailing list.
- Attend a planning meeting with representatives from USEPA.
- Prepare and distribute name tags, Site maps, and other handouts (for estimating purposes, 150 pages of handouts per tour is assumed).
- Attend the tour.
- Prepare an action items list following the tour.

3.2.4 Fact Sheet Preparation

Eighteen information letters/updates/fact sheets (hereinafter "fact sheets") will be prepared and will consist of:

- Two to four 8 ½" x 11" pages. In the case of four page fact sheets, an 11" x 17" sheet will be folded to 8 ½" x 11" size. Draft Fact Sheet content will be provided to USEPA for review. Upon receipt of comments from USEPA, laid out fact sheets will be provided to USEPA for comment and final approval.
- Double-sided black and white reproduction.
- Recycled paper (USEPA choice of color; samples will be provided).
- 400 copies, provided to USEPA ready for mailing.

The fact sheets will include text, USEPA logo, recycling logo, clip art (if appropriate), existing maps, or photographs; revisions to existing maps may also be performed. The estimate does not include preparing original artwork or illustrations, although these services may be provided, if requested. A separate budget estimate for such services will be submitted if requested. To allow for flexibility in fact sheet length, the fact sheets may be sent as self-mailers or mailed in envelopes.

3.2.5 Proposed Plan Support

This subtask includes coordination and assistance in the production of the draft and final Proposed Plan describing the preferred alternative and other alternatives evaluated in the Feasibility Study. The plan will be prepared in accordance with the National Contingency Plan and USEPA Community Relations in Superfund - A Handbook (most current version). The plan also will describe opportunities for community involvement in the decision-making process.

The plan will consist of:

• A maximum of 16, 8½" x 11" pages. Four 11" x 17" sheets will be folded to create an 8½" x 11" size booklet.

- Saddle-stitching (staples along seam).
- Double-sided black and white reproduction.
- Recycled paper (USEPA choice of color; samples will be provided).
- 500 copies.

It is assumed that USEPA will prepare the initial draft of the Proposed Plan and forward it for editing and lay-out. Existing Site location and Site lay-out maps will be incorporated into the plan as needed. Two draft Proposed Plans and two final Proposed Plans incorporating USEPA comments are assumed.

Following USEPA approval of the final Proposed Plan, the plan will be duplicated, placed in envelopes and address labels affixed. The Proposed Plans will be sent to USEPA for distribution to the appropriate parties on the Site mailing list. Copies will be submitted to the information repositories.

3.2.6 Public Notices

Eight public notices will be prepared to publicize the public meetings, Site tours, and public comment period on the Proposed Plan. One draft and one final version of each notice will be prepared. Upon USEPA approval, the notices will be placed as display advertisements in <u>The Home News & Tribune</u> (daily newspaper) and the <u>South Plainfield Reporter</u> (weekly newspaper).

3.2.7 <u>Information Repositories</u>

Copies of all final deliverables will be maintained in the information repositories for the duration of the work assignment. The reproduction and delivery costs are included with each separate subtask.

In addition, as part of this subtask, Foster Wheeler Environmental will maintain the information repositories as follows:

- USEPA will provide Foster Wheeler Environmental with a current file index, which will be forwarded to IT.
- IT will visit the information repositories once and check the contents of the repositories against the file index.
- Foster Wheeler Environmental will notify USEPA of IT's findings in writing.
- If any community relations documents generated by IT are missing, IT will replace them. If any technical documents generated by Foster Wheeler Environmental are missing, Foster Wheeler Environmental will replace them. If any other documents are missing, Foster Wheeler Environmental assumes USEPA will provide a copy that can be forwarded to the repository.

3.2.8 Site Mailing List

The existing Site mailing list will be updated six times. The mailing list will have approximately 330 entries. After each update, IT will submit a copy of the mailing list to the USEPA via e-mail or diskette. Mailing labels will be provided to USEPA upon request.

3.2.9 Responsiveness Summary Support

A responsiveness summary will be prepared that presents a concise and complete summary of significant oral and written comments that USEPA receives from the public during the public comment period. All written and verbal comments received during the public comment period will be compiled, organized and summarized with appropriate responses. Policy-oriented comments will be forwarded to USEPA for input.

A draft Responsiveness Summary will be submitted to USEPA following receipt of all public comments from USEPA. The final Responsiveness Summary will be submitted to USEPA following receipt of USEPA's comments on the draft Responsiveness Summary. Foster Wheeler Environmental will provide USEPA with six copies of the final Responsiveness Summary.

3.3 TASK 3 - FIELD INVESTIGATION

Foster Wheeler Environmental's field investigation program will be divided into the following three major elements:

- Site Reconnaissance
- Phase I Environmental Sampling
- Phase II Environmental Sampling

The Site Reconnaissance will consist primarily of non-intrusive investigation methods (e.g., wetland delineation/characterization, land/building survey, geophysical survey, soil gas survey) focused on clarifying the working hypotheses for the Site and determining and marking of precise sampling locations. Intrusive methods that will be conducted during the reconnaissance phase include excavation of test pits to define the boundaries of a dump/fill area and potentially locate contamination source areas, collection of dust samples from horizontal surfaces in on-site buildings, and sampling of soils on residential and commercial properties adjacent to the Site.

The Phase I investigation will then focus primarily upon determining local geologic/hydrogeologic conditions, potential source areas and overall characterization of Site-related contamination, with a relatively small number of measurement/sampling locations. Samples collected during Phase I will be analyzed for a wide range of constituents to provide comprehensive contaminant characterization. The rationale and specific analysis for Phase I samples are presented in Tables 3-1 and 3-2, respectively. More precise vertical and horizontal delineation of contaminated zones identified during Phase I will be the focus of the Phase II environmental sampling.

The Phase I investigation will also include a comprehensive evaluation of both existing and newly-collected data (see Section 3.6). This will allow a thorough determination of the usability of any

TABLE 3-1 (Sheet 1 of 2) SUMMARY OF RECONNAISSANCE PHASE AND PHASE I INVESTIGATION SAMPLING PROGRAM, RATIONALE AND ANALYSES

Matrix	Location	Number of Samples	Rationale for Sampling	Laboratory Analyses
Soil Gas	Entire site (excluding floodplain areas and interior of buildings)	225	Determine possible source area(s) related to disposal of solvents	Field GC target VOCs
Total (Soil Gas)		225		
Test Pit Soil	Central portion of Site	10	Assist in delineating disposal area boundaries and characterize potential source areas.	VOCs, SVOCs, pesticides/PCBs, metals, cyanide
Residential/Commercial Soil (0 to 2 inches bgs and 16 to 18 inches bgs))	Nearby vicinity to Site	849	Previous sampling indicates PCB concentrations > 0.49 ppm on nearby residential properties. Assess PCB contamination of nearby commercial properties.	PCBs
Surface soil (0 to 6 inches bgs)	Northeastern floodplain area	2	Previous sampling indicates elevated concentrations of PCBs and metals.	VOCs, SVOCs, pesticides/PCBs, metals, cyanide, TOC, PCB congeners (1 sample)
Surface soil (0 to 6 inches bgs)	Eastern floodplain area	2	Previous sampling indicates elevated concentrations of PCBs and metals.	VOCs, SVOCs, pesticides/PCBs, metals, cyanide, TOC, PCB congeners (1 sample)
Surface soil (0 to 6 inches bgs)	Along Conrail right-of-way (property to northeast of Site)	6	Determine potential impacts of the right-of-way in the floodplain area.	VOCs, SVOCs, pesticides/PCBs, metals, cyanide, TOC
Surface soil (0 to 6 inches bgs)	Monitoring well locations; around Site	11	Evaluate potential surficial contamination and direct human exposure and ecological effects.	VOCs, SVOCs, pesticides/PCBs, metals, cyanide, TOC, PCB congeners (1 sample)
Subsurface soil (0 to 30 feet bgs)	Monitoring well locations; around Site	44	Evaluate potential subsurface contamination and potential leaching from soils to groundwater.	VOCs, SVOCs, pesticides/PCBs, metals, cyanide, TOC, grain size, PCB congeners (3 samples)
Subsurface soil (0 to 24 inches beneath covering)	24 Buildings on northwest portion of Site	144	Evaluate potential subsurface contamination and source areas.	VOCs, SVOCs, pesticides/PCBs, metals, cyanide
Total (Soils)		1,068		
Test Pit Groundwater	Central portion of Site	10	Characterize potential source areas and evaluate potential leaching from sources/soils to groundwater.	Low concentration VOCs, low concentration SVOCs, low concentration pesticides/PCBs, metals, cyanide.

TABLE 3-1 (Sheet 2 of 2) SUMMARY OF RECONNAISSANCE PHASE AND PHASE I INVESTIGATION SAMPLING PROGRAM, RATIONALE AND ANALYSES

Matrix	Location	Number of Samples	Rationale for Sampling	Laboratory Analyses			
Hydropunch® Groundwater	Monitoring well locations; around Site	11	Evaluate potential for zones of groundwater contamination and identify potential contaminant migration pathways.	Low concentration VOCs, low concentration PCBs			
Groundwater [MW01 through MW11]	Monitoring well locations; around site	11	Evaluate potential bedrock groundwater contamination and potential leaching from sources/soils to groundwater. Also evaluate potential transport of contaminants from overlying zones (as available). Determine vertical potentiometric gradient.	Low concentration VOCs, low concentration SVOCs, low concentration pesticides/PCBs, metals, cyanide, haloacetic acids, conventional water quality parameters, PCB congeners (3 samples)			
Total (Groundwater)		32					
Water	Drainage system catch basins, floor drains, manholes, etc.		Determine potential for drainage system as contaminant source.	Low concentration VOCs, low concentration SVOCs, low concentration pesticides/PCBs, metals, cyanide			
Sediment	Drainage system catch basins, floor drains, manholes, etc.	5	Evaluate potential drainage sediment contamination; determine potential for drainage system as contaminant source.	VOCs, SVOCs, pesticides/PCBs, metals, cyanide			
Total (Drainage System)		10					
Dust 24 Buildings on northwest portion of Site		24	Determine levels of indoor contamination	PCBs, metals			
Total (Dust)		24					

TABLE 3-2 SUMMARY OF ANALYTICAL PROGRAM - RECONNAISSANCE PHASE AND PHASE I INVESTIGATION

Sample Type	Target Volatile Organic Compounds	TCL Volatile Organic Compounds	TCL Semi- Volatile Organic Compounds	TCL Pesticide/PCB Compounds	TCL PCB Compounds	PCB Congeners	Low Concentration Volatile Organic Compounds	Low Concentration Semi-Volatile Organic Compounds	Low Concentration Pesticide/PCB Compounds	Low Concentration PCBs	TAL Metals	Cyanide	Geotechnical Parameters	Haloacetic Acids	Water Quality Parameters	Field Measurements
SOIL GAS	225 (12)						,									
SOILS		·				-										
Test Pit		10 (1)	10 (1)	10 (1)				,		·	10 (1)	10 (1)				
Residential/Commercial			-		849 (43)			-				:				
Surface		21 (2)	21 (2)	21 (2)		3 (1)		_			21 (2)	21 (2)	21 (2)*			
Subsurface Well Borings		44 (3)	44 (3)	44 (3)		3 (1)					44 (3)	44 (3)	44 (3)			
Subsurface Building Borings		144 (8)	144 (8)	144 (8)							144 (8)	144 (8)				
GROUNDWATER			,													
Test Pit				_			10 (1)	10 (1)	10 (1)		10 (1)	10 (1)				
Hydropunch			-				11 (1)		-	11 (1)						
Phase I Wells [Round I]					_	3 (1)	11 (1)	11 (1)	11 (1)		11 (1)	11 (1)		11 (1)	11 (1)	11
DRAINAGE SYSTEM									·							
Standing Water							5 (1)	5 (1)	5 (1)		5 (1)	5 (1)				
Sediment		5 (1)	5 (1)	5 (1)							5 (1)	5 (1)				
BUILDING INTERIOR (FLOOR DUST)					24 (2)					-	24 (2)					
BLANKS													·			
Field		. ~	48	48	44	8	21	10	10	11	66	58				
Drilling Water		参 校					2	2	2		2	2				
Trip							21									
DI Water							2	2	2		2	2				
Total .	225 (12)	224 (15)	272 (15)	272 (15)	917 (45)	17 (3)	83 (4)	40 (3)	40 (3)	22 (1)	344 (20)	312 (18)	65 (5)	11 (1)	11 (1)	11

Notes:

- The number provided in parentheses denotes the number of field environmental duplicate samples. The table does not include laboratory QA/QC samples.

 Low concentration volatile organic compound, semi-volatile organic compound, and pesticide and PCB parameter list stated in OLC02.1 or latest revision.

 TCL volatile organic compound, semi-volatile organic compound, and pesticide and PCB parameter list stated in OLM04.2 or latest revision.

 Metal parameter list stated in ILM04.1 or latest revision.

 Geotechnical parameters include grain size and/or total organic carbon.

 Water quality parameters include total organic carbon, dissolved organic carbon, total suspended solids, total dissolved solids, ammonia, nitrate-nitrite, total phosphorus, hardness, chloride, chlorite, and bromate. The number of QA/QC blanks are estimated on the basis of one trip blank per day when aqueous VOC samples are collected, and one field blank per decontamination event (not to exceed one per day per type of sampling equipment).
- *TOC only.

existing results (e.g., those associated with the ecological risk assessment of portions of the Bound Brook adjacent to and downstream of the Site). This data evaluation task will also include determining if any data gaps exist that can be addressed by performing the appropriate focused sampling and analysis during the Phase II investigation.

As discussed above, Phase II sampling will be designed primarily to provide horizontal and vertical delineation of contaminated zones, and to address any data gaps as required to support subsequent phases of the investigation (e.g., risk assessment, contaminant fate and transport, and feasibility study). The Phase II analyses will likely be limited to a subset of constituents based on the Phase I sampling and analytical results. More informed decisions regarding the need for and design of treatability studies to assess potential remedial alternatives can also be made following review of the Phase II results.

The following sections provide a more detailed discussion of the activities that will be performed in each phase.

3.3.1 Site Reconnaissance

A survey will be conducted to update the existing property boundary, utility rights-of-way, surface drainage features (including discharge locations where discernable), and topographic survey information for the Site (see Figure 3-1), and to provide these data in an AutoCAD Version 14 electronic format. This format will facilitate the incorporation of Site survey information into the project Geographic Information System (GIS). The survey will be presented in the New Jersey State Plane coordinate system using the NAD 1983 horizontal datum, and the NGVD 88 elevation datum. A survey will also be conducted to define general property boundaries and structure locations as required within the adjacent residential/commercial area to facilitate the layout of surface soil sampling grids. This survey area will be contiguous with that of the Site proper, and will be included in the same electronic format, but will include significantly less detail.

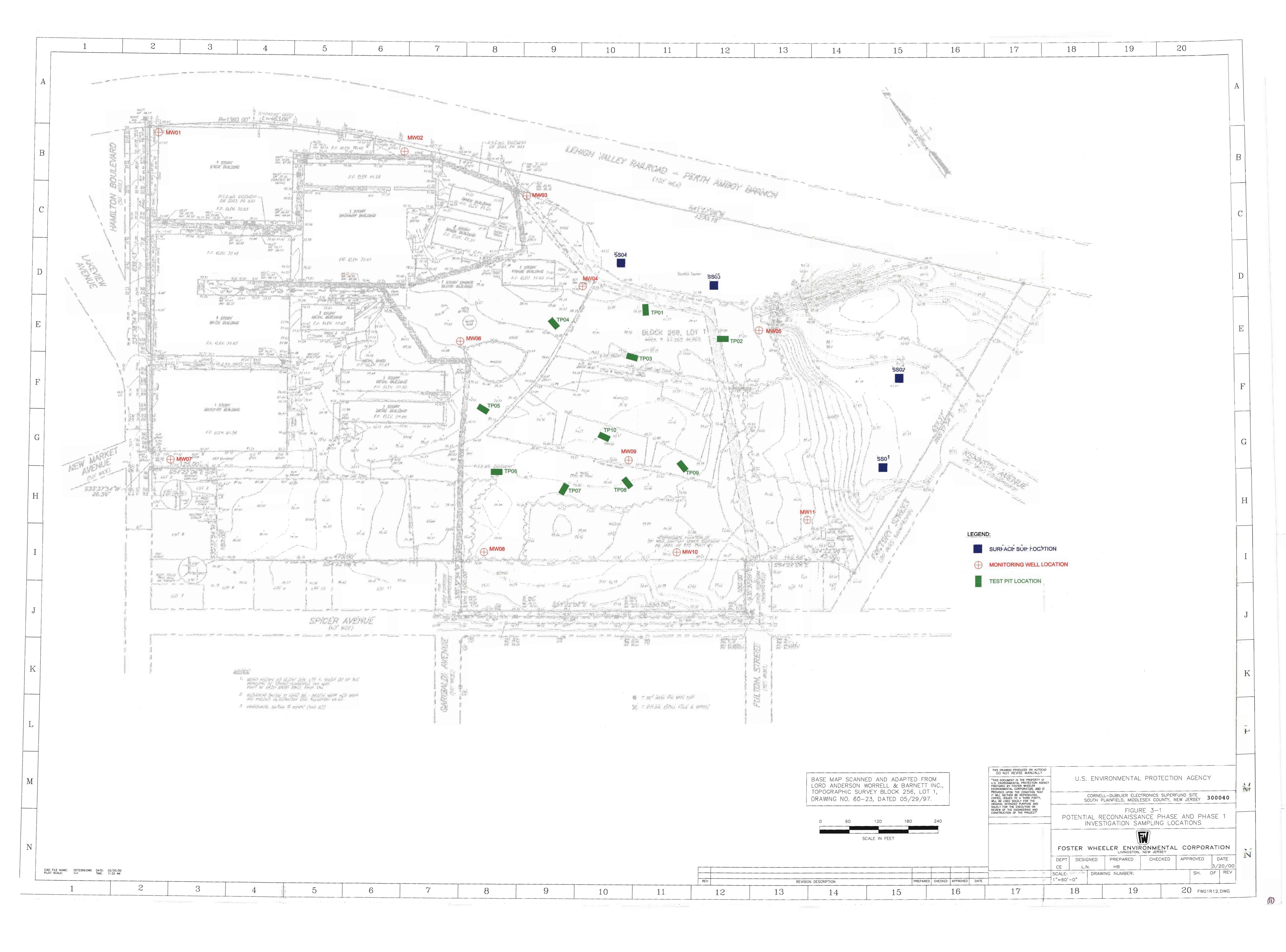
In addition, the Site Reconnaissance will include the following activities:

- Ecological Resources Reconnaissance
- Well Inventory
- Establishment of Sampling Points
- Soil Gas Survey
- Surface Geophysical Survey
- Test Pit Excavation
- Surface and Shallow Subsurface Soil Sampling
- Building Dust Sampling

Details of each of these activities are discussed in the paragraphs that follow.

3.3.1.1 Ecological Resources Reconnaissance

An ecological resources reconnaissance of the Site will be performed by Foster Wheeler Environmental using the *Checklist for Ecological Assessment/Sampling* (Appendix B, Representative



Sampling Guidance Document, Volume 3) in support of the ecological setting characterization required for the baseline ecological risk assessment for the Site. The ecological risk assessment will be conducted in accordance with the Ecological Risk Assessment Guidance for Superfund Process for Designing and Conducting Ecological Risk Assessments, Interim Final (ERR 540-R-97-006, OSWER 9285.7-25, PB97-963211, June 1997. A detailed presentation of the overall ecological characterization of the Site is presented in Section 3.3.6, including discussion of the wetland and habitat delineation, function and value assessment, endangered species or species of special concern and wildlife surveys, which will be conducted during the Site reconnaissance.

3.3.1.2 Well Inventory

Foster Wheeler Environmental will prepare an inventory of water supply wells (public or private) that lie within a one-mile radius of the Site, or that lie within or just outside (within 1/4 mile) of the "Interim Ground-Water Impact Area" defined by the NJDEP during their investigation of the Pitt Street private wells (NJDEP, 1991); see Figure 1-1. This inventory will be based upon a review of documents obtained from the NJDEP Bureau of Water Allocation, discussions with officials and file reviews at local health departments, and door-to-door surveys in locations nearest to the Site and/or in older neighborhoods more likely to have private wells. The locations of these wells will subsequently be posted on all groundwater contaminant isoconcentration maps prepared for the Site to illustrate the relationship of existing groundwater use to any Site-related groundwater contamination. The potential influence of water withdrawal from any of these wells on groundwater flow directions at the Site will also be considered.

The well inventory task will also include location of three abandoned on-site production wells. The approximate locations of these wells will be determined from DSC of Newark's response to EPA's Request for Information, dated April 8, 1999; and the NJDEP Bureau of Water Allocation records. An attempt will then be made to determine the precise locations of these wells through the use of surface geophysical techniques. This work will employ the same equipment as the Surface Geophysical Survey (Section 3.3.1.5) and be performed concurrent with or immediately following the survey of potential subsurface disposal areas.

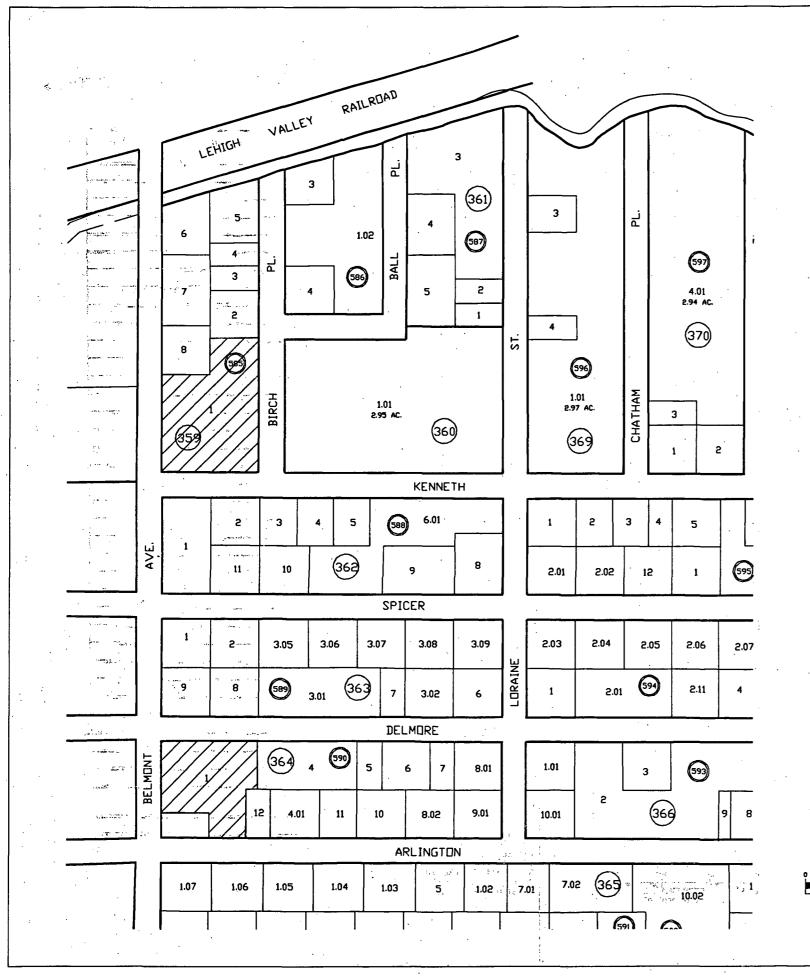
3.3.1.3 Establishment of Sampling Points

Sampling grids will be established on a total of 36 residential or commercial properties located in the vicinity of the Site to facilitate collection of surface and shallow subsurface soil samples for PCB analysis. These sampling grids will be submitted to USEPA for approval prior to sample collection. Table 3-3 presents the number of samples to be collected on each property, identified by lot and block number or street address. Properties that will be sampled are shown on Figures 3-2 through 3-5. This additional sampling was defined by the USEPA to allow statistically significant determination of the average point of exposure concentration for each property and to be consistent with previous sampling in the community (see Section 3.1.3).

An assessment will also be made of all Reconnaissance and Phase I sampling locations identified in this Work Plan (see Figure 3-1) to identify potential access problems and/or lateral or overhead clearance restrictions. Appropriate utilities will be contacted to mark the location of all known utilities within the study area. In addition, focused magnetometer surveys will be conducted to screen

TABLE 3-3 SUMMARY OF RESIDENTIAL AND COMMERCIAL SOIL SAMPLING LOCATIONS

Location	Number of Surface Soil Samples	Number of Subsurface Soil Samples					
Block 256, Lot 11	20	5					
Block 335, Lot 1	19	5					
Block 335, Lot 8.01	13	5					
Block 338, Lot 1	19	5					
Block 338, Lot 4	19	5					
Block 338, Lot 9	18	5					
Block 339, Lot 9	18	5					
Block 339, Lot 4	18	5					
Block 339, Lot 15.01	19	5					
Block 340, Lot 7	19	5					
Block 340, Lot 4.01	11	5					
Block 341, Lot 8	20	. 5					
Block 342, Lot 13	20	5					
Block 343, Lot 13	20	5					
Block 345, Lot 16	20	5					
Block 347, Lot 8.01	20	5					
Block 348, Lot 11	20	5					
Block 349, Lot 2	20	5					
Block 355, Lot 8	20	. 5					
Block 359, Lot 1	19	5					
Block 364, Lot 1	19	5					
321 Spicer Avenue	19	5					
405 Spicer Avenue	19	5					
408 Hamilton Blvd.	19	5					
417 Hamilton Blvd.	19	5					
123 Delmore Avenue	0	20					
334 Hancock Avenue	. 20	5					
312 Fred Allen Drive	20	5 .					
308 Fred Allen Drive	20	5					
213 Schillaci Lane	20	5					
221 Schillaci Lane	20	5					
223 Lowden	20	5					
232 Lowden	20	5					
230 Oakmoor	20	5					
251 Oakmoor	20	5					
South Plainfield Diner (address not available)	12	0					
Total	659	190					





RESIDENTIAL/COMMERCIAL PROPERTY TO BE SAMPLED

> BASE MAP ADAPATED FROM WESTON FIGURE 4 - SOIL SAMPLE LOCATIONS AND TOTAL PCB RESULTS, CORNELL-DUBILIER ELECTRONICS, SOUTH PLAINFIELD, NEW JERSEY RESIDENTIAL/NEIGHBORHOOD SAMPLING AREAS 4, MAY 5, 1998

REVISION DESCRIPTION PREPARED CHECKED APPROVED DATE THIS DRAWING PRODUCED ON AUTOCAD DO NOT REVISE MANUALLY U.S. ENVIRONMENTAL PROTECTION AGENCY

"THIS DOCUMENT IS THE PROPERTY OF U.S. ENVIRONMENTAL PROTECTION AGENCY PREPARED BY FOSTER WHEELER ENVIRONMENTAL CORPORATION, AND IS PROVIDED UPON THE CONDITION THAT IT WILL NEITHER BE REPRODUCED, COPIED, ISSUED TO A THIRD PARTY, WILL BE USED SOLELY FOR THE ORIGINAL INTENDED PURPOSE AND SOLELY FOR THE EXECUTION OR REVIEW OF THE ENGINEERING AND CONSTRUCTION OF THE PROJECT" CORNELL-DUBLILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, MIDDLESEX COUNTY, NEW JERSEY

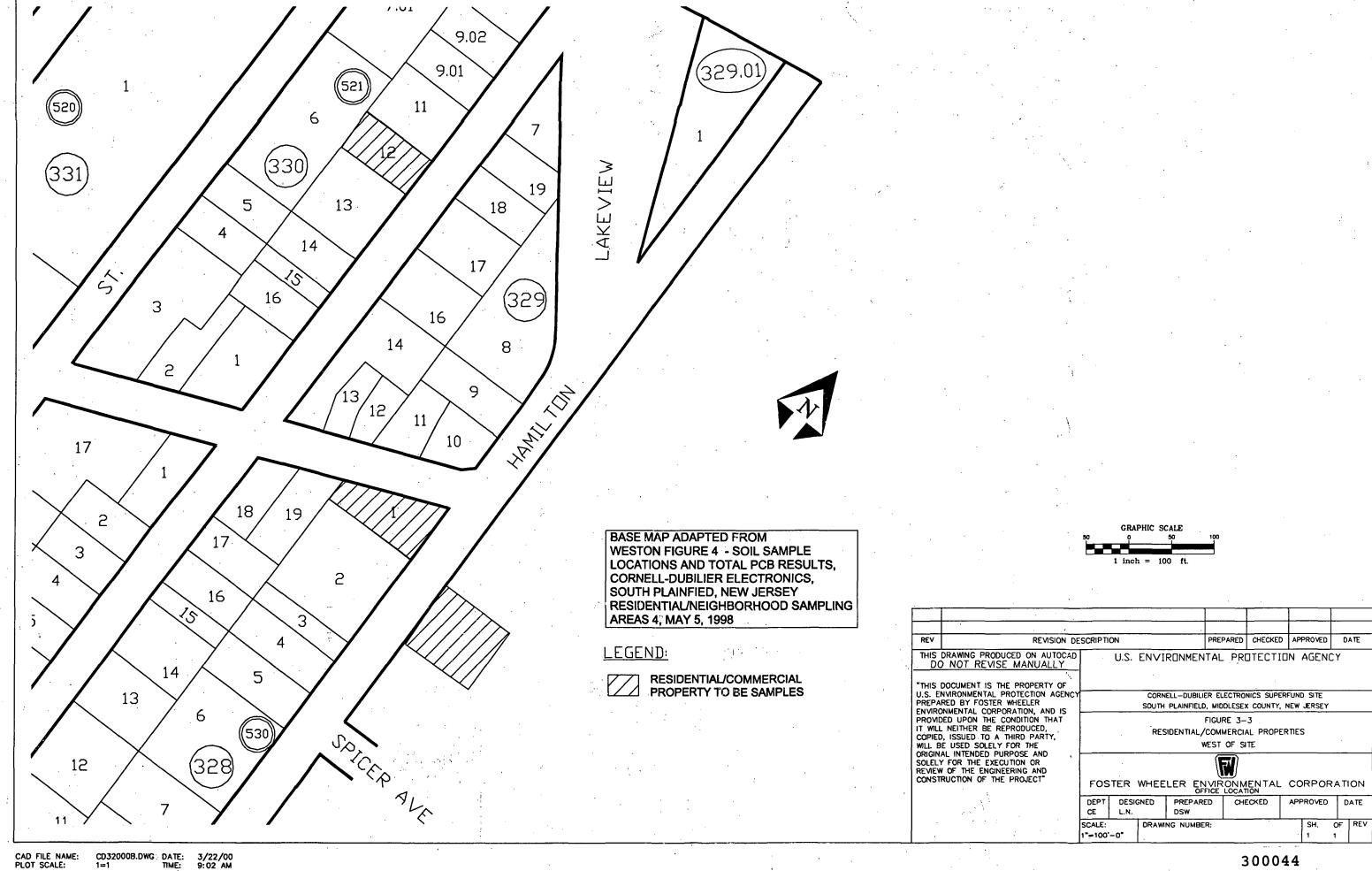
CONSTRUCTION OF THE PROJECT"

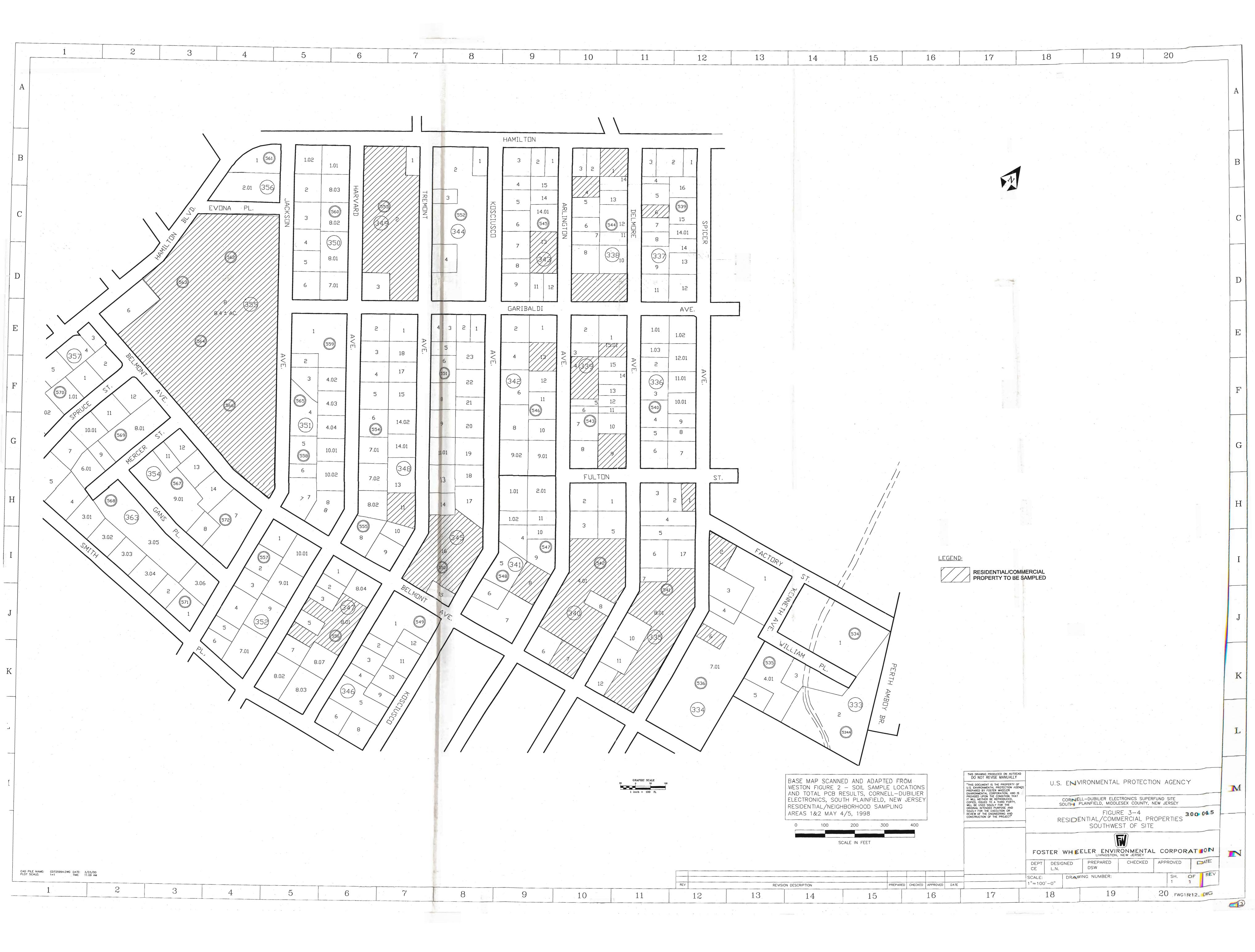
1 INCH = 200'-0"

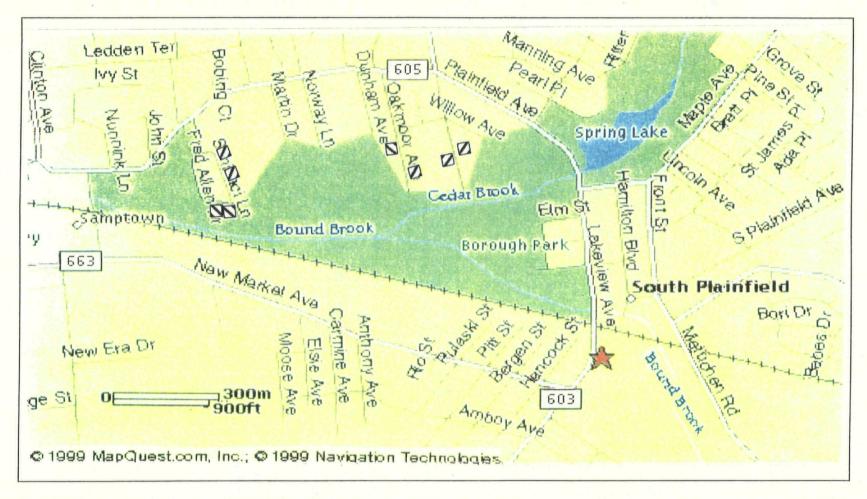
FIGURE 3-2. RESIDENTIAL/COMMERCIAL PROPERTIES SOUTHEAST OF SITE

FOSTER WHEELER ENVIRONMENTAL CORPORATION OFFICE LOCATION APPROVED CHECKED DATE DESIGNED PREPARED

CE L.N. DSW SCALE: DRAWING NUMBER 1"=200'-0"









BASE MAP ADAPTED FROM WWW.MAPQUEST.COM FIGURE FOR LOCATING THE PROPERTY AT 333 HAMILTON BOULEVARD, SOUTH PLAINFIELD, NJ.



RESIDENTIAL/COMMERCIAL PROPERTY TO BE SAMPLED

9₹000€

US ENVIRONMENTAL PROTECTION AGENCY

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, MIDDLESEX COUNTY, NEW JERSEY

FIGURE 3-5

RESIDENTIAL/COMMERCIAL PROPERTIES NORTHWEST OF SITE

FOSTER WHEELER ENVIRONMENTAL CORPORATION

the subsurface sampling locations for the presence of buried objects such as underground storage tanks or buried containers. Sample locations will be moved as necessary and the final locations will be clearly marked to facilitate later identification and surveying.

A visual survey will be performed within and around the 24 Site buildings to locate active or former sumps, pits, floor drains, and catch basins. Municipal construction records will be reviewed to gather available information on Site drainage systems. Dye testing will then be performed as necessary to determine the discharge locations of active catch basins and/or floor drains. Known locations of former underground storage tanks (USTs) and aboveground storage tanks (ASTs) will also be evaluated. A total of 72 soil sample locations, an average of three per building, will be located to target sampling of these features. All manhole covers will be removed to determine whether standing water and/or sediment is present. Catch basins and manholes will be marked for collection of standing water and/or sediment samples where they are present and collection of a sample is feasible. It is estimated that a total of 5 standing water and 5 catch basin/manhole sediment sample locations will be marked for sampling during the Phase I investigation. Integrity tests may be conducted as required based upon the results of the reconnaissance and Phase I investigations.

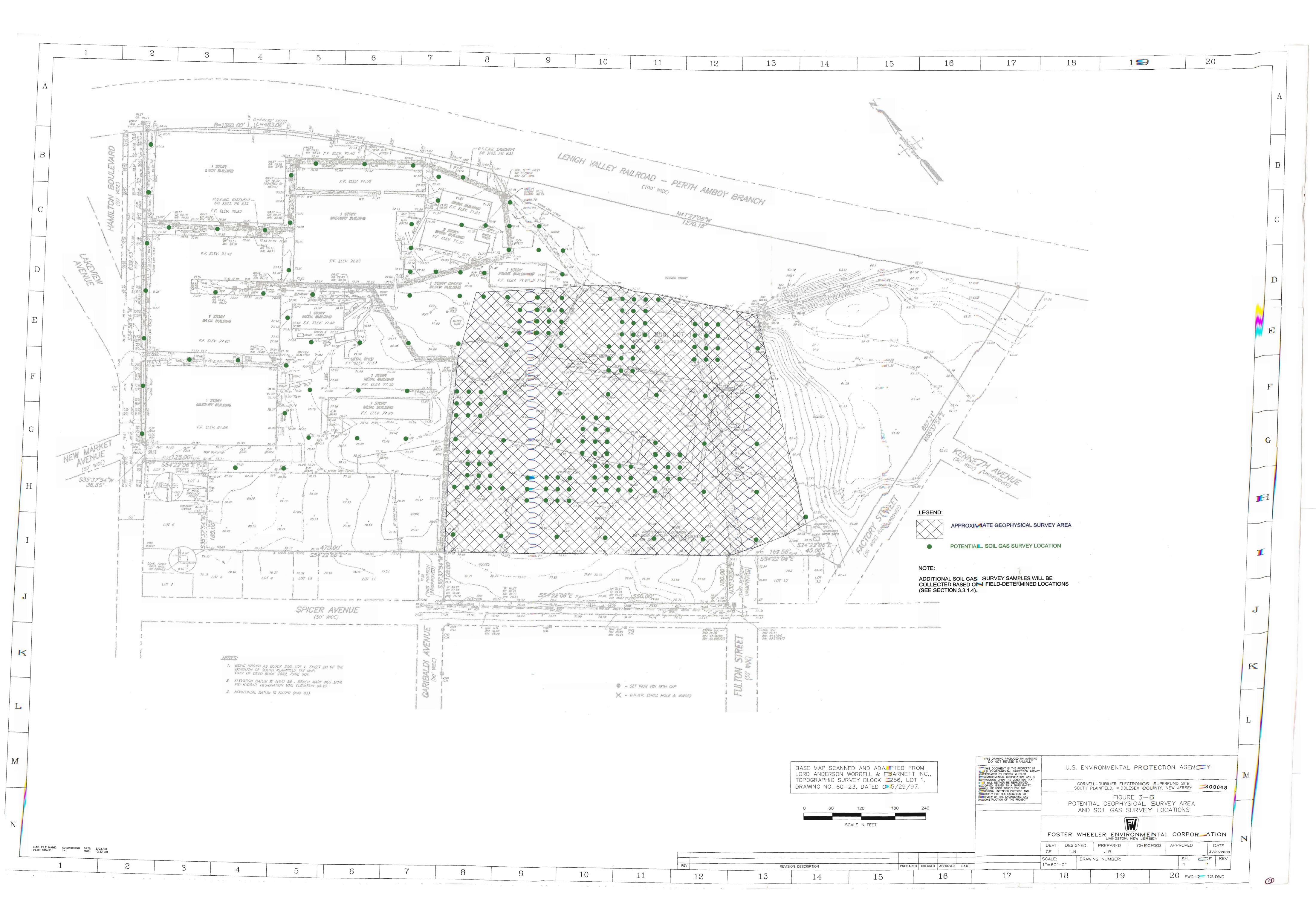
A total of 6 surface soil sample locations will also be identified along the railroad right-of-way north of the Site, where it is adjacent to the Bound Brook. The purpose of these samples will be to determine the potential for stream and/or floodplain contaminants to be derived from the railroad grade.

All proposed sampling locations will be submitted to the USEPA for review and approval. Should Foster Wheeler Environmental determine that the proposed sampling locations presented in this Work Plan require modification, by either substitution, addition and/or deletion, a Field Change Request (FCR) will be issued and the USEPA will be notified of any modifications for concurrence and approval of the final number and locations. Additional information on FCRs is presented in Section 13.0 of the QAPP (Part C of the FOP).

3.3.1.4 Soil Gas Survey

A soil gas survey will be performed around the Site to determine possible source areas for volatile organic contamination that are potentially related to disposal of TCE or other solvents used as degreasers. A 100 foot by 100 foot rectilinear grid will be established on a majority of the Site, with soil gas samples collected at the grid nodes (see Figure 3-6). Additional soil gas samples will be collected at 25 foot by 25 foot grid nodes in the vicinity of the test pit locations, at 50 foot by 50 foot grid nodes around the east-northeast Site buildings (large pits were present in the basement of these buildings, and a sheen was noticed on the standing water within the pits), and at any other additional areas determined during the field investigation (e.g., potential discharge locations determined from dye testing, elevated levels present during real-time sampling, etc). Actual sampling locations will be adjusted in the field to ensure sampling in vegetated areas between on-site buildings.

Active soil gas sampling from depths of approximately 4 to 5 feet below the ground surface (bgs) will be performed. The probe depth will be reduced if water is encountered. Pressure will be monitored and recorded at regular intervals throughout the survey period. Any required changes to the soil gas survey will be documented by a Field Change Request. The results of the soil gas survey



will be used in conjunction with other Site Reconnaissance results to confirm final test pit, monitoring well and surface soil sampling locations for the Phase I field investigation.

3.3.1.5 Surface Geophysical Survey

A geophysical investigation will be carried out at the Site with the primary objective being to delineate areas possibly utilized for subsurface disposal of industrial wastes, such as transformers and capacitors. Delineation of disposal areas will allow for a more focused and efficient sampling program during subsequent phases. Sampling locations may be located downgradient of potential disposal areas to determine if these areas act as contaminant sources. Also, boring locations can be adjusted to avoid large subsurface metallic bodies, thereby avoiding the expense associated with multiple boring attempts due to subsurface refusal. Furthermore, additional valuable subsurface information may be derived from this study, including:

- Mapping of existing Site utilities;
- Detection of underground storage tanks (USTs) and/or other potential contaminant source areas; and,
- Potential delineation of possible contaminant migration pathways and/or contaminant plumes, if sufficient geophysical signature allowing differential from background exists.

If potential disposal areas prove to act as contaminant sources, the results of the geophysical investigation may also provide important information necessary for a removal action.

Foster Wheeler Environmental will utilize two geophysical methods in the study: magnetometry and frequency-domain electromagnetic induction (FDEMI). Magnetometry can detect ferrous metallic targets, such as a single 55-gallon drum, at a depth of up to 15 ft bgs; FDEMI can provide location of subsurface metallic targets (ferrous and non-ferrous) as well as delineate areas of non-metallic subsurface debris, provided a large enough conductivity contrast exists between the non-metallic debris and native soils. FDEMI may also detect large contaminant concentrations in soil or groundwater if a large conductivity contrast exists between contaminated and non-contaminated media.

The geophysical investigation will be carried out within the southeastern half of the site. The study area consists of approximately 12 acres of fairly level property, ranging from paved to fairly heavily vegetated. The area of investigation is bounded to the southwest by Spicer Avenue, to the southeast by a steep slope, to the northeast by a chain link fence beyond which is a wooded swamp, and to the northwest by industrial buildings. The study area will be fully surveyed with both geophysical methods. To simplify data acquisition and analysis, the survey area will be divided into approximately 10 to 20 sub-plots ranging in size from 0.25 to 1 acre.

Concurrent with geophysical data acquisition, cultural features maps will be developed which will detail the location of potential interferences such as buildings, fences, utilities, etc.

Magnetometry and FDEMI data will be processed and interpreted using manufacturer-supplied software, Foster Wheeler Environmental developed proprietary software, and the GEOSOFT Oasis Montaj Data Processing and Analysis System. Magnetrometry and FDEMI data will be interpolated

to accurate New Jersey State Planar coordinates (relative to NAD83), appropriate shifts and filters will be applied, and data will be extrapolated to a regularly spaced grid system using accepted mathematical methods. These data will then be displayed as high-resolution color maps.

A final report including description of data collected, maps of the geophysical data, and interpretation of these data will be included in the RI Report.

3.3.1.6 Test Pit Excavation

A total of 10 test pits will be excavated within the central portion of the Site to assist in delineating the boundaries of the potential dump/fill area and to identify and characterize potential additional source areas. Tentative locations for the test pits are shown on Figure 3-1. However, Foster Wheeler Environmental will use the combined results of other Reconnaissance investigations, including the soil gas and geophysical surveys, to adjust these locations as necessary to provide the most useful information.

Final test pit locations will be submitted to the USEPA for review and approval prior to excavation and any significant modifications, by either substitution, addition and/or deletion, will be documented by a Field Change Request.

Although the primary reason for the test pit program is to determine the physical characteristics and boundaries of the potential disposal area, Foster Wheeler Environmental has assumed that an average of one soil sample and one groundwater sample will be collected from each test pit. This will provide a contingency for collection of samples for chemical analysis in the event that stained or odoriferous soils, groundwater with a sheen or odors, or high organic vapor readings (flame ionization or photoionization detector; FID or PID) are encountered. The soil samples will be analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and pesticide/PCB compounds (Pesticide/PCBs); and Target Analyte List (TAL) metals and cyanide. The groundwater samples will be analyzed for low concentration VOCs, SVOCs and Pesticide/PCBs; and TAL metals and cyanide.

3.3.1.7 Surface and Shallow Subsurface Soil Sampling

Surface (0 to 2 inch depth) and shallow subsurface (16 to 18 inch depth) soil samples will be collected from a total of 36 residential or commercial properties located in the vicinity of the Site (see Section 3.3.1 - Site Reconnaissance) for PCB analysis. A total of 849 primary soil samples (659 surface, 190 subsurface) and 43 duplicate soil samples (33 surface, 10 subsurface) will be collected and analyzed for TCL PCBs only. Table 3-3 presents the number of samples to be collected on each property. Properties that will be sampled are shown on Figures 3-2 through 3-5. Although such sampling is not traditionally considered to be reconnaissance, this sampling is scheduled to be performed during the Site Reconnaissance to facilitate the continued progress of an ongoing USEPA remedial action in the community. Additional on-site surface soil sampling that is not directly related to this remedial action will be conducted during the Phase I field effort. The need for additional surface and/or shallow subsurface soil sampling in residential areas along the Bound Brook downstream of the Site will be further evaluated and defined following review of the Reconnaissance and Phase I sampling results.

3.3.1.8 Building Dust Sampling

Composite samples of dust from horizontal interior building surfaces (i.e., floors) will be collected by vacuum to assess potential levels of indoor contamination (see Section 3.3.6 of the FSP). A total of 24 primary samples (one per building) and 2 duplicate samples will be collected and analyzed for TCL PCBs and TAL metals.

3.3.2 Mobilization and Demobilization

Foster Wheeler will provide the necessary personnel, equipment and materials for mobilization and demobilization from the Site.

Mobilization will encompass the following activities:

- Coordinate efforts of mobilization/demobilization subcontractor (includes installation and setup of utilities and temporary facilities)
- Prepare list of required field equipment
- Inventory available Foster Wheeler Environmental equipment
- Prepare requisitions to lease or purchase equipment
 [see Attachment 1 for list of equipment for lease/purchase analysis]
- Prepare requisitions to purchase expendable field supplies
- Arrange delivery, storage and setup (as necessary) for all equipment
- Perform general Site preparation/organization
- Establish health and safety zones
- Conduct initial health and safety briefing for all project team members

Demobilization will include the following activities:

- Coordinate efforts of mobilization/demobilization subcontractor (includes removal of utilities and temporary facilities)
- Demobilize any field equipment or laboratories used
- Perform necessary Site restoration

3.3.3 <u>Hydrogeological Assessment</u>

Foster Wheeler Environmental will conduct the following activities under this subtask:

- Test boring and monitoring well installation and development
- Groundwater elevation measurements
- Surface water elevation measurements
- Hydraulic testing (pump tests)

Additional details regarding these tasks are provided in the following sections. The potential need for downhole geophysical investigation of the bedrock aquifer will be assessed following receipt of the results of the Phase I investigation (see Section 3.6 - Data Evaluation). If warranted, downhole geophysics would then be recommended in the Phase II Work Plan Addendum.

3.3.3.1 Test Boring and Monitoring Well Installation

Eleven monitoring wells (MW01 through MW11) will be installed in the bedrock aquifer, with open borehole wells installed to total depths at least 10 feet below the point where groundwater is first encountered. As discussed in Section 1.2.3, the depth to the competent bedrock surface is assumed to be approximately 30 feet bgs. These open borehole wells will allow measurement of the general potentiometric conditions within the bedrock aquifer, and will also allow packer tests to be performed to evaluate the vertical hydraulic gradient and/or differential permeability within the bedrock aquifers (Phase II). Tentative monitoring well locations are shown on Figure 3-1.

Boreholes will first be drilled to the competent bedrock surface (an approximate depth of 30 feet) using hollow-stem auger methods. Soil samples will be collected by continuous split-spoon sampling until auger and/or split spoon refusal prevents further borehole advancement. The subsurface lithology will be logged by a Site geologist as described in the FOP. Soil samples will be collected for chemical analysis as described in Section 3.3.5. If groundwater is encountered within the unconsolidated overburden or weathered bedrock, direct-push Hydropunch® or equivalent methods will be used to collect samples for chemical analysis.

The boreholes will then be reamed using water rotary drilling methods to allow installation of a temporary surface casing. Drilling will then continue for installation of the bedrock monitoring wells. The first 10 feet of competent bedrock will be cored and visually inspected for fractures and potential staining, then the bedrock will be reamed to accept the permanent surface casing. After the grout has set for a minimum of 24 hours, coring of the bedrock will be continued to a depth at least 10 feet below the point where groundwater is first encountered. The borehole will then be reamed to the appropriate final diameter for the monitoring well (see Procedure #12A). If the depth at which groundwater is encountered requires that the borehole extends to a depth greater than 25 feet below the bottom of the surface casing (the maximum open-hole length allowed by NJDEP), the monitoring well will be completed using a stainless-steel screen and riser (see Procedure #12A).

Monitoring wellheads will either be completed with the top of the housing approximately 1 inch above the surrounding grade, i.e., "flush-mounted," or will extend approximately 3 feet above the ground surface, depending upon field conditions and access requirements. All monitoring wells will be developed no sooner than 48 hours and no longer than 2 weeks after completion as described in the FOP. The locations and elevations of all completed monitoring wells will be determined and recorded by a surveyor licensed by the State of New Jersey.

3.3.3.2 Groundwater Elevation Measurements

Groundwater elevation measurements will be performed in all monitoring wells prior to each round of groundwater sampling (see FOP). An attempt will be made to perform measurements for all wells within the shortest practicable time frame to avoid errors in the potentiometric gradient caused by temporal variations in the water table elevations.

3.3.3.3 Surface Water Elevation Measurements

A stream gauge will be installed in the Bound Brook adjacent to the Site at a point that is relatively easy to access for viewing. Elevation markings on the stream gage will be relative to mean sea level, and will be established by a surveyor licensed by the State of New Jersey. Surface water elevations will be recorded in conjunction with all rounds of groundwater elevation measurements.

3.3.3.4 Hydraulic Testing

A 72-hour pumping test that incorporates guidelines described in ASTM Method D4050-91 will be performed during the Phase II investigation. Foster Wheeler Environmental will follow the general aquifer testing procedure given in the FOP. However, the detailed design of the pumping test will be prepared following receipt of all Phase I investigation results. This design will then be presented for USEPA review and approval in the Work Plan Addendum for the Phase II investigation.

3.3.4 Soil Boring, Drilling, and Testing

A total of 72 shallow (i.e., 2 feet to 3 feet deep) soil borings will be installed within and/or around Site buildings and structures for the purpose of sampling soils to identify potential contamination source areas (see Section 3.3.1 - Site Reconnaissance). A pavement surface, if present, will first be cored to provide access to the underlying soil. One soil sample will be collected at the ground surface (0 to 6 inch depth, with 6 to 12 inch depth for VOCs) or within the 6-inch interval immediately below the pavement material and underlying crushed stone. A second soil sample will be collected from 12 to 24 inches (18 to 24 inches for VOCs) below the ground surface (or below the base of crushed stone as appropriate).

A total of 11 soil borings will be drilled to the competent bedrock surface (an approximate depth of 30 feet), using hollow-stem auger methods. Soil and/or weathered bedrock samples will be collected by continuous split-spoon sampling to the top of the competent bedrock. Four subsurface soil samples will be collected for chemical analysis, with the actual depth of two of the four subsurface soil samples being dependent upon visual and instrumental headspace VOC screening analyses (see Section 3.3.5). If groundwater is encountered within the unconsolidated overburden or weathered bedrock, direct-push Hydropunch® or equivalent methods will be used to collect groundwater samples to bedrock. See Section 3.3.5 for details related to environmental sampling and analysis.

Foster Wheeler Environmental will provide technical oversight and health and safety monitoring for the drilling subcontractor and all sampling personnel.

3.3.5 Environmental Sampling

Foster Wheeler Environmental will conduct a variety of environmental sampling activities over the course of the investigation, including:

- Field screening
- Groundwater sampling
- Surface soil sampling

- Soil boring/permeability sampling
- Surface water and sediment sampling
- Drainage system standing water and sediment sampling
- Air monitoring

Additional details regarding these tasks are provided in the following sections.

3.3.5.1 Field Screening

Foster Wheeler Environmental will perform field screening on subsurface soil samples collected from the monitoring well soil borings. This field screening will consist of analyzing the headspace above an aliquot of the sample in a covered glass jar using a handheld flame ionization detector (FID) and a handheld photoionization detector (PID) organic vapor analyzers. The results of this screening analysis will be used in conjunction with visual observations of the soil characteristics (e.g., visible staining) to determine which split spoon sample from a given depth interval will be submitted for laboratory analyses (see Soil Boring/Permeability Sampling section below).

3.3.5.2 Groundwater Sampling

One complete round of groundwater samples will be collected from the 11 newly installed monitoring wells during the Phase I investigation. All monitoring wells will be purged and sampled in accordance with Procedure #19B of the FOP, which complies with the USEPA Region II low stress groundwater purging and sampling procedure provided as Attachment D to the FSP. All groundwater samples will be analyzed for low concentration VOCs, SVOCs and Pesticide/PCBs; TAL metals and cyanide; haloacetic acids; and conventional water quality parameters (total organic carbon, dissolved organic carbon, total suspended solids, total dissolved solids, ammonia, nitratenitrate, total phosphorus; hardness; chlorides; chlorite; and bromate). In addition, three monitoring well samples (MW04, MW06 and MW09) will be analyzed for PCB congeners. Groundwater samples collected from the bedrock monitoring wells will be considered representative of the conditions in the upper portion of the bedrock aquifer at the Site. At least one additional round of groundwater sampling will be included in the Work Plan Addendum for the Phase II investigation. If groundwater is encountered within the unconsolidated overburden or weathered bedrock, installation of permanent overburden monitoring wells will also be considered for the Phase II investigation.

3.3.5.3 Surface Soil Sampling

Surface soil samples (0 to 6 inches bgs, with 6 to 12 inches bgs for VOCs) will be collected at a total of 15 on-site locations during the Phase I investigation:

- 11 monitoring well locations;
- 2 locations in the northeastern portion of the Site, in the flood plain area along Bound Brook;
- 2 locations in the eastern portion of the Site, in the flood plain area along Bound Brook.

These locations are shown in Figure 3-1. An additional 6 surface soil samples will be collected along the railroad right-of-way north of the Site, where it is adjacent to the Bound Brook. All Phase I surface soil samples (a total of 21 primary samples and 2 duplicates) will be collected using hand tools (e.g., shovel, trowel) and will be analyzed for TCL VOCs, SVOCs and Pesticides/PCBs; TAL metals and cyanide; and total organic carbon (TOC). In addition, three surface soil samples (SS02, SS03 and MW09) will be analyzed for PCB congeners.

Results of the SLERA and consultation with the BTAG (SMDP #1) will determine the need to conduct additional ecological sampling as part of the BERA. Such activities could include confirmatory sampling or testing to fulfill the needs to test postulated, if deemed necessary, risk hypotheses.

Additional surface soil sampling will be proposed in support of the terrestrial biota sampling and bioassay/toxicity tests to be scoped and budgeted as part of the Phase II Work Plan Addendum. The final extent of sampling, chemical analyses and selection of species to be sampled and testing to be performed will be determined following review of available USEPA data and reports (Task 1), completion of the screening level ecological risk assessment (Task 7) and completion of the ecological reconnaissance.

The number of samples to be collected will be dependent upon the extent of the biota sampling program (i.e., small mammals, plants, soil invertebrates) and number of locations considered for bioassay and/or toxicity testing. A cursory review of the available reports reveals that the USEPA has collected an extensive number of overbank soils from the Bound Brook corridor. Therefore, it is anticipated that additional surface soil samples from the Site, the banks of Bound Brook and a selected reference station will be identified to support the biological/toxicological testing to be developed in detail as part of the Phase II investigation Work Plan Addendum.

3.3.5.4 Soil Boring/Permeability Sampling

As discussed in Section 3.3.4, a total of 72 shallow soil borings will be installed within and around Site buildings and structures for the purpose of sampling soils to identify potential contamination source areas. Two soil samples will be collected from each boring (total of 144 primary and 8 duplicate samples), and will be analyzed for TCL VOCs, SVOCs and Pesticides/PCBs; and TAL metals and cyanide.

A total of 11 soil borings will be drilled to the bedrock surface using hollow-stem auger drilling methods. Groundwater will be sampled using direct-push Hydropunch® or equivalent methods, at 10-foot intervals, to determine whether zones of groundwater contamination are present and to identify potential contaminant migration pathways in the overburden and/or weathered bedrock. Due to potential limitations in the volume of groundwater that may be collected using Hydropunch® techniques, these samples will be analyzed only for VOCs (to address the potential TCE contamination) and PCBs (the primary Site contaminant). Based upon the low potential to encounter permanently saturated conditions in the overburden and/or weathered bedrock (see Section 1.2.3), an estimate of 1 Hydropunch® sample will be collected from each soil boring. A total of 12 (11 primary, 1 duplicate) Hydropunch® samples will therefore be collected and analyzed for low concentration VOCs and low concentration PCBs.

A total of four subsurface soil samples will also be collected from each of these borings for laboratory analysis. One sample will be collected from the overburden depth interval between 2 feet bgs and the top of weathered bedrock, with the actual depth interval selected to represent the zone with the highest potential contamination as determined on the basis of visual and instrumental screening. One sample will be collected at the top of weathered bedrock. One sample will be collected between the top of weathered bedrock and the top of competent bedrock, with the actual depth interval also selected to represent the zone with the highest potential contamination as determined on the basis of visual and instrumental screening. The last sample will be collected from immediately above the competent bedrock. A total of 44 primary and 3 duplicate subsurface soil samples will be collected from the monitoring well soil borings to be analyzed for TCL VOCs, SVOCs and Pesticides/PCBs; TAL metals and cyanide; TOC; and grain size. In addition, the soil sample collected in the overburden interval (unless visual and/or instrument screening indicates a significantly more contaminated sample from a deeper soil zone) in borings MW04, MW06 and MW09 will be analyzed for PCB congeners.

3.3.5.5 Surface Water and Sediment Sampling

USEPA (1998) has performed extensive sampling in Bound Brook and the unnamed tributary to Bound Brook that adjoins the Site boundary. However, it is anticipated that in support of the bioassays/toxicity tests and biota sampling efforts, additional sampling of surface water and sediments will be required. The number and location of samples will be determined and proposed sampling locations identified as part of the Work Plan Addendum for the Phase II investigation.

The final extent of sampling, chemical analyses and selection of species to be sampled and bioassay/toxicity testing to be performed during Phase II will be determined following review of available data and historical reports (Task 1: Site Reconnaissance Phase), completion of the screening level ecological risk assessment (Task 7 in part: Phase I) and completion of the ecological reconnaissance (Task 3 in part: Site Reconnaissance Phase). The number of samples to be collected will be dependent upon the extent of the biota sampling program and the number of locations considered for bioassay/toxicity testing or confirmatory chemical sampling. A cursory review of the available reports reveals that the USEPA has collected an extensive number of sediment samples from the Bound Brook corridor and the unnamed tributary. It is anticipated that additional surface water and sediment samples from the unnamed tributary, the Bound Brook, New Market Pond, Spring Lake and an alternative reference location may be needed to support the biological/toxicological studies and to fill any potential data gaps identified from the existing data set.

3.3.5.6 Drainage System Standing Water and Sediment

As stated previously in Section 3.3.1 - Establishment of Sampling Points, the presence of standing water and/or sediment within drainage system locations (e.g., catch basins, manholes, etc.) will be noted. During the Phase I investigation, samples of the water and/or sediment will be collected to determine the level of contamination within the Site drainage system and its potential as a Site source. It is estimated that a total of 5 standing water samples will be obtained, and analyzed for low

concentration VOCs, SVOCs, and Pesticides/PCBs; and TAL metals and cyanide. In addition, approximately 5 sediment samples will be collected for analysis of TCL VOCs, SVOCs, and Pesticides/PCBs; and TAL metals and cyanide.

3.3.5.7 Air Monitoring

In addition to real-time air monitoring that will be performed to assess the potential for health and safety risks during the performance of the field investigation, air samples will be collected during Phase II from each on-site building to support the baseline human health risk assessment. These samples may be collected for the following analyses: VOCs; SVOCs and Pesticides/PCBs; metals; and/or asbestos.

3.3.6 Ecological Characterization

The Site and habitats associated with the Bound Brook and New Market Pond will be characterized with regard to ecological resources to provide the requisite data to conduct an ecological risk assessment (ERA) in accordance with the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, Interim Final (EPR 540-R-97-006, OSWER 9285.7-25, PB97-963211, June 1997; or ERAGS). The ecological characterization of the Site will include completion of the checklist for Ecological Assessment/Sampling found in Appendix B Representative Sampling Guidance Document, Volume 3 of ERAGS. Additionally, Site-specific studies may be designed with consultation and guidance from the EPA BTAG to assess the effects of contaminants on indigenous populations and determine their overall bioavailability. The need for additional Site-specific studies will be based on review of historic documents, the results of the habitat characterization, SLERA and consultation with BTAG. If required, these additional studies will be conducted as part of the Phase II investigation. Section 3.7.2 provides a more detailed discussion of the ERA process, directly addressing Steps 1 through 7 of ERAGS.

The studies to be performed as part of the Site Reconnaissance or the Phase I investigation will include wetland and habitat delineation, function and value assessment; wildlife observation and surveys; and identification of endangered species or other species of concern. These tasks are discussed in detail in the following sections and will be used as part for the problem formulation for the screening level ecological risk assessment. Remaining tasks including benthic reconnaissance/community characterization; biota sampling/population surveys; bioassays/toxicity tests; and bioaccumulation studies are provided in general terms, and the final scope of work for these subtasks will be developed and detailed as part of the Phase II Work Plan Addendum.

3.3.6.1 Wetland and Habitat Delineation, Function and Value Assessment

Wetlands within the Site Study Area (i.e., the Site proper and the Bound Brook corridor) will be identified during the Site Reconnaissance to determine if potential remedial activities will impact these areas. Foster Wheeler Environmental is proposing to delineate wetlands on the Cornell-Dubilier property and immediately adjacent to the property boundaries. Wetlands within the remainder of the Study Area will be identified from U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps, New Jersey State Freshwater Wetland Maps, and recent aerial photography.

Wetlands on and adjacent to the Cornell-Dubilier property will be delineated using the Routine Onsite Determination Method of the Federal Manual. This method incorporates a three-parameter approach using vegetation, soils, and hydrology to identify the presence of freshwater wetlands (Federal Interagency Committee for Wetland Delineation, 1989). Delineated wetlands will be surveyed by a licensed surveyor onto a wetland delineation plan.

Preliminary review of the USFWS NWI maps and New Jersey State Freshwater Wetland Maps revealed extensive areas of wetlands throughout the Bound Brook corridor. The undeveloped portions of the Bound Brook corridor are composed of palustrine forested, scrub/shrub, and emergent wetlands and open waters. Due to the amount of wetlands and the expansive Study Area, wetlands associated with the Bound Brook downstream of the Site will be identified through an in-office review of maps and recent aerial photography.

Based on the information collected from these maps and photos, approximate wetland boundary lines will be incorporated on to a wetland boundary map. The wetland boundary map will concentrate on the wetlands within the Bound Brook corridor, i.e. the area within the banks and immediately adjacent to the Bound Brook, from the Cornell-Dubilier property to New Market Pond. The flood plain of the Bound Brook will also be included on the wetland boundary map. The flood plain boundaries (i.e., flood hazard area, 100-year flood plain and 500-year flood plain) will be derived from the appropriate NJDEP flood hazard maps for the Bound Brook and the Federal Emergency Management Agency (FEMA) flood insurance rate maps. A field inspection of the wetland boundary map will be performed during the Site Reconnaissance to verify the accuracy of the mapped wetlands.

Several scenarios may occur which would require the formal delineation of the wetland boundaries within all or part of the Bound Brook corridor. Under such circumstances, the wetlands within the Bound Brook Corridor would be delineated during a later phase in the project, using the USACE's Routine On-Site Methodology. The following are scenarios that would justify further delineation of wetlands within the Bound Brook corridor:

- During the Reconnaissance investigation, the extent of wetlands within the Bound Brook corridor is determined to be much less extensive then portrayed on the wetlands maps. If wetlands are observed to be less extensive, then they will be delineated during the Phase II investigation.
- During the Phase I and Phase II investigation, if contamination is identified within wetlands to such an extent that would require the evaluation of potential wetland impacts resulting from remediation then the wetlands will be delineated during the Phase II investigation.

All additional wetland delineations and field surveys will be performed under the authorization of the USEPA. As required, a Work Plan Addendum would be prepared prior to delineation of the wetlands.

If, during the Phase I and Phase II sampling events, contamination is detected in the wetlands within the Site Study Area to such an extent that would require evaluation of potential wetland impacts resulting from remediation, then functional assessment will be performed as part of the Phase II. The

Army Corps of Engineers Wetland Evaluation Technique (WET) (Adamus et al. 1987) will be used to assess functions and values of wetlands located on-site. A total of 14 functions and values will be rated in terms of social significance, effectiveness, and opportunity. Social significance reflects the values society places on the particular function and value by virtue of economic worth or official recognition. Effectiveness is the inherent capability of a wetland to perform a function based on its physical, chemical or biological characteristics. Opportunity is the probability that a wetland performs a function to its capacity.

The WET Analysis outlines the procedure to evaluate the current and potential future values for each of the following functions:

- Groundwater recharge/discharge;
- Flood storage and desynchronization;
- Sediment toxicant retention:
- Nutrient retention/transformation;
- Nutrient export;
- Fish and wildlife habitat;
- Endangered species;
- Consumptive and passive recreation; and
- Uniqueness/heritage.

If during Phase I and Phase II sampling efforts, contamination is detected within the Site Study Area wetlands and floodplains to such an extent that would require evaluation of remediation impacts, then an assessment of the wetlands and floodplains will be performed following the requirements set forth in Executive Order 11988, "Floodplain Management"; Executive Order 11990, "Protection of Wetlands"; and USEPA's Statement of Policy on Floodplain and Wetland Assessments for CERCLA Actions.

As part of the RI/FS process, measures would be investigated to minimize potential adverse effects to the wetlands and floodplains. Any proposed wetland impact will conform to the substantive requirements of the New Jersey Freshwater Wetland Protection Act and Section 404 of the Federal Clean Water Act. Impacts to the floodplains will conform to substantive requirements of New Jersey's Flood Hazard Area Control Act and the Environmental Review Procedures outlined in USEPA's 1985 Statement of Policy on Floodplain and Wetland Assessments for CERCLA Actions.

Impacts of potential remedial actions within wetlands and floodplains will be assessed in the RI/FS. The assessment will include a discussion of the effects of all alternatives, including the proposed remedial action.

In addition to delineating wetlands within the Site Study Area, a qualitative vegetation habitat survey will be performed to identify terrestrial habitats. The qualitative vegetation habitat survey will consist of identifying the vegetation communities present, and the communities will be characterized by identifying and recording dominant vegetation within four stratum: tree, woody shrub/sapling, herbs, and woody vines. Representative vegetation stations will also be recorded within the vegetation communities. Incidental wildlife species observed during the field efforts will also be recorded.

3.3.6.2 Wildlife Observation and Surveys

Wildlife resources of the Site, the Bound Brook corridor and New Market Pond will be qualitatively investigated in support of a baseline characterization of wildlife occurrence and usage in these areas. As part of this task, wildlife observations will be defined as direct and indirect field observations of mammals, aviafauna, reptiles and amphibians. The objectives of the observations are the documentation of faunal composition of the Site and adjoining areas for establishing the context of the ecological setting for the Site, and for use in identifying ecological resources and values for use in the ecological risk assessment for the Site. Surveys will be conducted in the wetlands associated with the Site and the floodplain corridor of the Bound Brook, extending from the Site downstream to New Market Pond. An appropriate reference area upstream from the Site will also be investigated to provide a basis for qualitatively comparing wildlife utilization of habitats not affected by the Site but subject to other kinds of year to year stresses.

Wildlife usage of the area will be evaluated based upon qualitative observations, both direct (i.e., visual observation of wildlife species) and indirect (i.e., tracks, dens, scat or calls/songs for birds). A limited search of habitats will be performed to locate the more secretive species of reptiles and amphibians in riparian and upland areas. On the Site, a qualitative survey will be performed to identify wildlife species that may utilize undeveloped portions of the Site as potential habitat. For the wetland and terrestrial habitats associated with the Bound Brook and New Market Pond, a line transect survey methodology will be employed. Two transects (a north bank and a south bank transect) will be surveyed twice a day for five consecutive days. The daily surveys will be conducted once during the early morning and once during early evening (i.e., crepuscular periods) to document occurrences of any wildlife based upon qualitative observations. Data to be collected will include type of observation (i.e., direct or indirect), a description of the observation (i.e., track, call, scat, etc.), species observed, a general description of the habitat the observation was made in and any other significant observations. In addition to the above transect surveys, incidental observations made during the wetland delineation and vegetation cover type surveys will also be included. A limited literature search will also be performed to determine if historical studies on wildlife species in the vicinity are available for supporting documentation.

3.3.6.3 Identification of Endangered Species and Others of Special Concern

Foster Wheeler Environmental will request a threatened and endangered species documentation search within the Site Study Area from the NJDEP, Natural Heritage Program. USEPA will initiate an informal Section 7 Consultation with the USFWS to request a threatened, endangered and species of special concern documentation search. USEPA will notify Foster Wheeler Environmental of the results.

If a habitat search and Section 7 Consultation are required, this additional work will be defined and recommended in the Phase II Work Plan Addendum.

3.3.6.4 Benthic Reconnaissance/Community Characterization

The USEPA (1998) performed an ecological risk assessment of the Bound Brook and New Market Pond, and determined that the benthic community was impacted from contaminants potentially related to the Cornell-Dubilier Site. This study will be reviewed and assessed for usability directly

Tech\RAC\Cornell_Dub\WP.wpd 300060 or in part (i.e., data) for the RI/FS as part of the Reconnaissance/Phase I effort (Task 6: Data Usability). If, after consultation with the USEPA, the determination is made not to employ this study in whole or in part, a benthic macroinvertebrate survey will be developed as part of the Phase II Work Plan Addendum, and will be performed in conjunction with other biota studies during the Phase II sampling effort.

Four replicate macroinvertebrate samples will be collected from stations in the Bound Brook, New Market Pond, Spring Lake, and appropriate reference stations. Benthic sampling stations will be identified based upon similar habitat characteristics. Benthic samples will be collected using identical sampling means at each station.

If this subtask is required, the number of sampling locations and samples to be collected will be developed and presented in the Phase II Work Plan Addendum. In addition, a detailed scope and associated level of effort estimate for this subtask (benthic reconnaissance/community characterization) would also be developed and presented as part of the Phase II Work Plan Addendum.

3.3.6.5 Biota Sampling/Population Surveys

Biota sampling may consist of population based surveys and/or body burden analyses for contaminant levels of representative biota from the Site environs and adjacent areas of the Bound Brook flood plain. To the greatest extent possible, recent historical biota studies conducted by ESD (USEPA, 1993a and 1993b) and ERT (USEPA, 1998) will be used, and additional field efforts developed to fill potential data gaps and further reduce uncertainty in the risk assessment. Key efforts may include sampling of the following biota for community level data and/or body burden analyses:

- Fish communities present in the Bound Brook and New Market Pond;
- Small mammals from the Site and the Bound Brook flood plain; and
- Plants and invertebrates from the Site and the Bound Brook flood plain.

Fish Community Assessment and Sampling

Characterization of the fish community will provide information on the overall health of the fishery present in Bound Brook and New Market Pond. The purpose for the fish community surveys will be to:

- Qualitatively observe the fish community composition and structure in the Bound Brook and New Market Pond in comparison to identified reference fish communities; and
- Observe and document any overt effects in resident fish species potentially linked to exposure to contaminants associated with the Site.

USEPA (USEPA 1993, 1998) evaluated the fish communities as part of the initial Site investigation and determined that the freshwater fishery present in the Bound Brook was degraded. Sampling of select fish species and tissues revealed the presence of contaminants potentially related to the Site. Foster Wheeler Environmental will review and evaluate the data for use in the Screening Level Ecological Risk Assessment (SLERA) and Baseline Ecological Risk Assessment (BERA) for the

Site. Forage fish (i.e., pumpkinseed sunfish) were collected as whole body samples; however, benthic and piscivorous fish species were collected for fillet tissue only. It is anticipated that for the Phase II investigation for this RI/FS, a limited amount of fish collection may be necessary for collection of discrete organ tissues and carcass tissue samples of a benthic and/or piscivorous fish species for chemical analysis. Surveys may be conducted in the Bound Brook, New Market Pond, Spring Lake and appropriate reference stations.

Fyke nets, backpack or boat mounted electro shocking, gill nets or seines may be used to collect fish from both lotic and lentic environments. Electro shocking or block seining will likely be the most efficient method in the Bound Brook and its reference locations, and electro shocking, gill nets or seines in New Market Pond and its reference station. Final selection of the sampling methodology will be determined based on Site-specific conditions and data needs, and will be provided within the Phase II Work Plan Addendum.

The species used in tissue analysis may be a predatory species (i.e., *Micropterus* sp.) or a benthic species (i.e., *Ictalurus* sp.). Species and collection methods used in the reference areas will be identical to those used in the downstream sampling points and habitats. Final selection of candidate species will be specified in the Phase II Work Plan Addendum.

Chemical analyses will be conducted on discrete tissues or whole carcasses of individual fish. However, if single fish do not provide enough tissue, composites will be used; and these will be made up of individuals from a single species, of the same sex (if applicable by species), within the same size range. Tissues may be analyzed for PCBs, pesticides, polycyclic aromatic hydrocarbons (PAHs), metals and percent lipids. However, this list of analyses will be modified/finalized following completion of the SLERA during Phase I of the investigation and detailed as part of the Phase II Work Plan Addendum.

Small Mammals

USEPA (1998) collected replicate whole body tissue samples of white footed mice (Peromyscus leucopus) from four downgradient sampling stations along the Bound Brook (inclusive of the Site area) and a single reference station. Liver tissues were resectioned for histopathological examination. Tissues were analyzed for PCBs, pesticides and percent lipids. Collected tissues were not analyzed for metals or semi-volatile organics. Pending a full review of the data and reports provided, and assuming that the collected tissue data from the USEPA (1998) study is fully usable, additional sampling of small mammals (i.e., white footed mice) will be performed to fill any analytical data gaps (i.e., metals) in the small mammal data set for use in the baseline ecological risk assessment. Replicate samples from each location will be collected from each terrestrial sampling area identified in the USEPA (1998) study. Collected individuals will be identified to species, sex determined and qualitatively aged (i.e., juvenile or adult based upon pelt coloration). Meristic measurements of collected individuals shall include head, body and tail length, and body weight. Whole body samples will be submitted for select analyses based upon review of available data. Additionally, co-located surface soil samples will be collected from the sampling area to characterize select contaminant concentrations in surface soils. Collection methods, final analyses to be performed, and number and placement of sample locations will be detailed as part of the Phase II Work Plan Addendum.

Soil Invertebrate and Terrestrial Plant Tissue Analyses

Results of the preliminary problem formulation and the SLERA will be used to determine if chemical sampling of terrestrial or wetland plants and invertebrates is necessary to evaluate risks to terrestrial receptors. This will be detailed as part of the refined problem formulation and toxicological evaluation in consideration of the findings of the habitat evaluations and wildlife observations.

Emergent vegetation may be sampled from the Bound Brook flood plain to determine if contamination from the Site is being bioaccumulated by plants and to evaluate if primary consumers in the food chain are being exposed to Site-related contaminants. Sampling of vegetation will likely be confined to the bank area of the Bound Brook between the Site and New Market Pond. Samples of above ground herbaceous growth will be collected by using a decontaminated stainless steel knife or scissors. Depending upon local abundance, a single species common to all the sampling areas will be selected for collection. If a single species is not available at all locations, a composite sample of several species from each area will be collected for analysis. Three replicate samples will be collected from each location and the composition by mass in each sample of each species comprising the sample will be recorded. Replicate vegetation samples, and a single surface soil (0 to 6 inches) sample will be collected from the approximate midpoint of the sampling area.

During the Site Reconnaissance, an assessment will be performed to determine if sufficient soil invertebrates are present in the terrestrial habitats associated with the Site and the Bound Brook flood plain to permit collection for tissue analysis. Representative soil invertebrates to be considered may include earthworms, pillbugs, snails or other invertebrates found to be common in the flood plain areas of the Bound Brook. If field reconnaissance reveals that collection of indigenous soil invertebrates from the flood plain is not practical, an earthworm bioaccumulation bioassay may be considered for potential application in evaluating the potential for soil biota to accumulate Siterelated contaminants using surface soils from the Site and study area. Final scoping for these collections will be determined as part of the Phase II Work Plan Addendum.

3.3.6.6 Bioassays/Toxicity Tests

Bioassays are valuable tools for measuring the toxicity of contaminant mixtures and their potential to accumulate in biota under controlled laboratory conditions. Toxicity tests will be performed using bulk surface water, sediments and surface soils collected from stations in the Bound Brook adjacent to and downstream from the Site and a corresponding reference station, and from stations in New Market Pond and a corresponding reference station in Spring Lake.

Representative toxicity tests to be performed for surface water samples will include chronic test exposures which may include, but not be solely limited to, the following:

- Seven day, Chronic Static Renewal Survival and Reproduction Test with the water flea, *Cerodaphina dubia* (EPA Method 1002.0); and
- Seven day, Chronic Static Renewal Larval Survival and Growth Test with the Fathead Minnow, *Pimephales promelas* (EPA Method 1000.0).

Final selection of test organisms and test protocols will be based upon identification of contaminants of concern in surface water. If contaminants possessing herbicidal properties are identified, the green algae Selenastrum capricornutum may also be used in toxicity studies. Bulk surface water samples will be of sufficient volume to meet the performance requirements for the above tests, in addition to sub-sampling for chemical analysis. Analyses may be modified based upon results of the SLERA in identifying contaminants of concern. Such modifications will be presented as part of a Work Plan Addendum to be prepared prior to the Phase II investigation.

Bulk sediment samples will be collected and homogenized in sufficient volume to meet the testing requirements for the selected whole sediment accumulation bioassays and toxicity tests. Representative toxicity tests to be performed on bulk sediment samples may include whole sediment chronic toxicity/bioassay tests which may include but not be limited to the following:

- Chronic, Survival, Growth and Maturation Tests using the amphipod Hyalella azteca;
- Chronic, Survival and Emergence Tests using the midge, Chironomus ssp.; and
- Chronic Larval Survival and Growth Tests using the fathead minnow, *Pimephales promelas*.

Additionally, bulk sediments will be sub-sampled and analyzed for TCL VOCs, SVOCs and Pesticides/PCB; TAL metals and cyanide; TOC; and grain size. Pending the results of the SLERA, the suite of analyses may be amended to address specific risk hypotheses formulated for the BERA.

Organisms used for toxicity tests will be selected based upon test organism tolerances to environmental conditions and properties of the media to be tested. Testing procedures shall be in accordance with ASTM and/or USEPA protocols. Final selection of testing protocols will be determined based upon the test organisms selected and in consultation with the USEPA. The selected analyses and evaluation approaches will be submitted for review and final approval by USEPA as part of the Phase II Work Plan Addendum.

3.3.6.7 Bioaccumulation Studies

Bioaccumulation studies will be used to assess bioavailability and bioaccumulative potential of sediment and soil contaminants to representative test species. In addition, secondary information related to survival and gross systemic effects can be collected as part of the exposure assessment. Concurrent with the field collections for toxicity/bioassay testing, laboratory bioaccumulation studies may be performed using bulk surface sediments collected from stations in the Bound Brook downstream from the Site and a corresponding reference station, and from stations in New Market Pond and a corresponding reference station. The test organism for the sediment evaluation will be the aquatic earthworm, *Lumbricus variegatus*. Guidance for performance of the test will be from USEPA (1994).

If during the Site Reconnaissance, it is determined that terrestrial soil invertebrates are not present in sufficient numbers to meet analytical requirements, a terrestrial invertebrate bioaccumulation bioassay will be employed to assess the bioaccumulative potential of soil contaminants. For surface soils, laboratory cultures of earthworms (*Lumbricus* sp. or *Eisenia* sp.) will be used to evaluate

toxicity/bioaccumulative potential of soil contaminants in soil invertebrates. Testing protocols will follow USEPA and/or ASTM guidance. These experiments will be run in the laboratory for greater control of experimental exposure conditions. Bulk soils will be collected, homogenized and split for analytical and bioassay testing. Final scoping and selection of test protocols will be detailed following completion of data review and the SLERA. The final selection of the number and placement of samples and the analyses to be performed will be provided for USEPA review in the Phase II Work Plan Addendum.

3.3.7 Geotechnical Survey

Surface geophysical activity conducted during the Site Reconnaissance phase of the investigation includes magnetometer and electromagnetic surveys (see Section 3.3.1). No geophysical investigations will be conducted during the Phase I investigation.

Past aerial photographs of the site and surrounding areas will be reviewed. However, no formal aerial photographic analysis will be included in the Phase I investigation. The necessity for various geotechnical survey activities will be re-evaluated following receipt of the Phase I investigation results. Potentially useful geotechnical activities that may be evaluated for the Phase II investigation include:

- Magnetometer Surveys
- Electromagnetic Surveys
- Ground-Penetrating Radar Surveys
- Seismic Refraction Surveys
- Resistivity Surveys
- Collection of Site Meteorological Data
- Cone Penetrometer Survey
- Remote Sensor Survey/Aerial Photographic Analysis

3.3.8 <u>Investigation Derived Waste (IDW) Characterization and Disposal</u>

All Investigation Derived Waste (IDW) generated during the field sampling efforts will be characterized and disposed of in accordance with local, state, and federal regulations. All expendables not contaminated by hazardous materials will be disposed of as conventional municipal solid waste. All soil cuttings; monitoring well purge/development water; unused samples; decontamination wash/rinse water; unused sample preservation and equipment decontamination fluids; and contaminated personal protective clothing, debris, and expendables generated on-site during the field investigations will be characterized to determine their appropriate disposition. Materials determined to be hazardous waste will be shipped to an acceptable treatment, storage, or disposal facility (TSDF) for disposal. All IDW characterization and disposal will be performed by a qualified subcontractor.

3.4 TASK 4 - SAMPLE ANALYSIS

This task only includes the environmental sample analyses. Excluded are efforts associated with and identified in Task 3, Task 5 and Task 6.

3.4.1 Innovative Methods/Field Screening Sample Analysis

Foster Wheeler Environmental will perform field screening associated with the soil gas survey and with the subsurface soil sample collection, both under Task 3 and described in Sections 3.3.1 and 3.3.5, respectively.

3.4.2 Analytical Services Provided via CLP or DESA or USEPA-ERT

Foster Wheeler Environmental will secure analytical services for all sample analyses available through the USEPA Contract Laboratory Program (CLP) or from the USEPA Division of Environmental Science and Assessment (DESA) Laboratory in Edison, New Jersey (see Table 3-2). These services include Target Compound List (TCL) Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), TCL Pesticides/PCBs, Target Analyte List (TAL) Metals and Cyanide, low concentration VOCs, low concentration SVOCs, and low concentration Pesticides/PCBs. Analyses which are not available through the CLP or from the USEPA DESA Laboratory will be analyzed by subcontract analytical laboratories (see Section 3.4.3).

3.4.3 Analytical Services Provided via Subcontract Laboratories

Foster Wheeler Environmental will secure analytical services via subcontract laboratories for the analysis of TAL metals in floor dust, PCBs in soil and floor dust, PCB congeners in soil and groundwater, low concentration PCBs in groundwater, geotechnical parameters in soil, haloacetic acids in groundwater, and water quality parameters in groundwater.

3.5 TASK 5 - ANALYTICAL SUPPORT AND DATA VALIDATION

Foster Wheeler Environmental will arrange with USEPA sample management personnel for the analysis and validation of all Routine Analytical Services (RAS) environmental samples collected during the field investigation program. RAS sample slots will be scheduled in the CLP via the Regional Sample Control Center/Contract Laboratory Analytical Support Services office (RSCC/CLASS). Foster Wheeler Environmental will arrange for the analysis of and perform the validation of all non-Routine Analytical Services (non-RAS) environmental samples collected during the field investigation program. The following subsections describe the activities Foster Wheeler Environmental will perform associated with the analysis and validation of all field sample results.

3.5.1 Collect, Prepare and Ship Samples

Foster Wheeler Environmental will prepare and ship all environmental samples collected from the Site under Task 3 in accordance with the Field Operations Plan found in Appendix A. A summary of the environmental and associated QA/QC samples to be collected by matrix type is provided in Tables 3-1 and 3-2 of this Work Plan. Foster Wheeler Environmental will procure and provide the sample containers for all environmental sampling. Arrangements will be made for sample shipment and delivery schedules with the appropriate subcontract laboratories, the CLP CLASS office, the RSCC, and/or the USEPA DESA Laboratory (Edison, New Jersey).

3.5.2 Sample Management

Foster Wheeler Environmental will provide sample management, including chain of custody procedures, information management, data storage, and sample retention. Communication will be maintained with the appropriate subcontract laboratories, the CLP CLASS office, the RSCC, and/or the USEPA DESA Laboratory (Edison, New Jersey) regarding the scheduling, tracking and oversight of the sample analyses and validation. In addition, Foster Wheeler Environmental shall oversee subcontracted laboratories in accordance with its USEPA-approved RAC II <u>Delivery of Analytical Services Plan</u> (July, 1998).

3.5.3 Data Validation

All CLP RAS data will be validated by USEPA Region II Hazardous Waste Support Section personnel in Edison, New Jersey. All non-RAS data analyzed by the USEPA DESA Laboratory in Edison, New Jersey will be validated by DESA Laboratory personnel. Foster Wheeler Environmental will provide data validation of all non-RAS data analyzed by subcontract laboratories (see Section 3.4.3), utilizing the non-RAS laboratory Statements of Work (SOWs), applicable sections of the USEPA National Functional Guidelines for Organic and Inorganic Data Validation, best professional judgement, and relevant sections of the following USEPA Region II Data Validation Standard Operating Procedures (SOPs):

- SOP No. HW-6: CLP Organics Data Review and Preliminary Review (CLP/SOW OLM04.2), Rev. 11, June 1996.
- SOP No. HW-2: Evaluation of Metals Data for the Contract Laboratory Program (CLP), Rev. 11, January 1992.
- SOP No. HW-13: Organic Data Review for Low Concentration Waters, Rev. 2, October 1996.

All Foster Wheeler Environmental data validators performing this task have been trained and are certified by USEPA Region II in validating the parameters of interest associated with the project. All data validation reports will be summarized according to USEPA Region II Data Validation SOPs.

3.6 TASK 6 - DATA EVALUATION

This task includes work efforts related to the compilation and evaluation of existing data and field sampling data obtained during this work assignment, and a discussion of the usability of all data. A Data Evaluation Summary Report will be prepared that summarizes the results of the Phase I investigation as well as those of previous investigations at the Site. The report will include a discussion of analytical results; a comparison (tabular format will be used) of prior sampling data with data obtained during this work assignment's investigatory phase; and a discussion of any apparent trends and/or discrepancies within the data. The Data Evaluation Summary Report will also identify additional data requirements for the Phase II investigation. These data requirements will be used as the foundation for preparation of the Phase II Work Plan Addendum, which will detail the activities to be performed during Phase II.

3.6.1 Data Usability Evaluation

Foster Wheeler Environmental will qualitatively evaluate the usability of existing data and additional data obtained during this work assignment's investigatory phase. Existing analytical data obtained during prior USEPA investigations at the site will be assumed to be acceptable, valid, and have appropriate QA/QC verification. However, review will be required to assess the useability of data associated with the ecological risk assessment prepared by the USEPA for portions of the Bound Brook adjacent to and downstream of the Site. Once all data associated with this risk assessment have been received by Foster Wheeler Environmental, a comprehensive data useability assessment will be performed and recommendations will be made regarding their potential use for the Baseline Ecological Risk Assessment that will be performed in accordance with EPA 540-12-97-006, ERAGS, dated June 5, 1997.

The usability of data obtained during this work assignment's investigatory phase will be qualitatively determined by examining data validation summary reports and verifying that the sampling procedures and analytical results were obtained following the applicable protocols, are of sufficient quality to satisfy DQOs, and can be relied upon for performing the Baseline Human Health and Ecological Risk Assessments. The results of this evaluation, along with an assessment of the suitability for use of the data obtained during past investigations, will be presented in a Technical Memorandum (Data Evaluation Report) to the USEPA (see Section 3.6.4).

3.6.2 Data Reduction, Tabulation, and Evaluation

All validated data assessed to be usable and relevant to the project will be complied and summarized in tabular format with an independent verification at each step in the process to prevent transcription/typographical errors. Any computerized entry of data will be verified and signed off as checked.

Tables of analytical results will be organized by matrix (e.g., soil, groundwater); analytical fraction (e.g., VOCs, metals); specific depth intervals sampled (e.g., surface soil/subsurface soil, shallow groundwater/bedrock groundwater); and/or segregated according to specific contaminant source area and/or other unique areas, if warranted. All analytical tables will identify individual samples by unique sample location/well identification numbers that correspond to those presented on Site sample location maps and will include the sample collection dates, detection limits for parameters not detected, and laboratory and/or data validation qualifiers. Standard units for results reporting (i.e., ug/L for groundwater; ug/kg for soil organics; and mg/kg for soil inorganic parameters) will be used in all tables, texts and figures used to summarize the analytical results. Analytical result tables will also specify the applicable standard or criterion for each constituent, and highlight any results that exceed these criteria. An explanation will be provided for any sample with detection limits greater than the applicable criteria.

The USEPA protocol for eliminating field sampling analytical results based on laboratory/field blank contamination results will be clearly explained. Discussion of approved sampling results will not be qualified by suggesting that a particular chemical is a common laboratory contaminant or was detected in a laboratory blank. If the reported result has passed QA/QC, it will be considered valid.

Field rinsate blank analyses will be discussed in detail if decontamination solvents are believed to have contaminated field samples.

All tabulated data to be utilized in the Baseline Human Health and Ecological Risk Assessments will be presented in a Technical Memorandum (Data Evaluation Report), discussed in Section 3.6.4, and provided to the USEPA for review and concurrence prior to its use in the risk assessments.

3.6.3 Modeling

No computer modeling will be performed during the Phase I investigation other than exposure point concentration models which are included within the human health and/or ecological risk assessment tasks. The need for geostatistical analysis for Site-related contaminant delineation and computer modeling of contaminant transport in groundwater or surface water will be re-evaluated following review of the Phase I results.

3.6.4 <u>Technical Memorandum (Data Evaluation Report)</u>

A Data Evaluation Report in the form of a Technical Memorandum will be prepared and submitted to the USEPA for review and approval. This report will include: 1) a tabulation of all data acquired during this work assignment; 2) a qualitative evaluation of the suitability for use of data obtained during prior investigations in the risk assessments along with justifications for excluding any past data (if warranted); 3) a Screening Level Ecological Risk Assessment (SLERA) based upon existing data and any data acquired during the Site Reconnaissance (see Section 3.7.2.1); and 4) a determination of the usability of the data obtained during the Phase I field effort. Additionally, the report will discuss any apparent trends in the data and the ability of the data to satisfy DQOs, and identify additional data requirements to be addressed by the Phase II investigation.

3.7 TASK 7 - ASSESSMENT OF RISK

3.7.1 <u>Baseline Risk Assessment (Human Health)</u>

Foster Wheeler Environmental will evaluate and assess the current and potential future risk to human health posed by exposure to contaminants identified at the Cornell-Dubilier Site. This evaluation and assessment will be presented in two (2) reports: a Pathways Analysis Report (described in Section 3.1.13), and a Human Health Risk Assessment Report. The following subsections present the principal elements addressed in the Draft and Final Human Health Risk Assessment Reports.

3.7.1.1 Draft Human Health Risk Assessment Report

Foster Wheeler Environmental will prepare a Draft Human Health Risk Assessment Report for the Site that addresses the following:

 Hazard Identification - Foster Wheeler Environmental will review available information on the hazardous substances present in the Site soils and identify the major Contaminants of Potential Concern (COPCs).

- Dose-Response Assessment The COPCs will be selected based on their intrinsic toxicological properties.
- Characterization of Site and Potential Receptors Affected human populations in the exposure pathways will be identified and characterized.
- Exposure Assessment An exposure assessment will be performed to identify the magnitude of actual or potential human exposures, their frequency of occurrence and duration, and the routes of exposure for the human receptors. This assessment will include the likelihood of occurrence, which will provide the basis for developing acceptable exposure levels, and reasonable maximum exposure estimates for both current and potential land use conditions at the Site.
- Risk Characterization Chemical-specific toxicity information, combined with quantitative and qualitative data from the exposure assessment, will be compared to measured contaminant exposure levels and the levels predicted through environmental fate and transport modeling. These comparisons will be utilized to determine if concentrations of soil contaminants at or near the Site are affecting or could potentially affect human health.
- *Identification of Limitations/Uncertainties* Critical assumptions (e.g., background concentrations and conditions) and uncertainties stated in the report will be discussed with respect to their impact on the risk characterization.
- Site Conceptual Model A conceptual model of the Site will be developed and presented based on the contaminants identified, the exposure and toxicity assessments, and the risk characterization.

3.7.1.2 Final Human Health Risk Assessment Report

After the Draft Human Health Risk Assessment Report has been reviewed and commented on by USEPA, Foster Wheeler Environmental will submit a written response to each comment to the USEPA for review. Any further resolution/clarification of specific comments or Foster Wheeler Environmental's responses will be rectified with the USEPA prior to revising the draft report.

Once required revisions are finalized and agreed to by USEPA, Foster Wheeler Environmental will revise the Draft Human Health Risk Assessment as warranted. The Final Human Health Risk Assessment Report will be submitted to USEPA after final resolution of USEPA comments. Additionally, upon acceptance by USEPA, an electronic copy of the Final Report will be submitted in HTML format to the USEPA Records Manager.

3.7.2 <u>Baseline Risk Assessment - Ecological Risk Assessment</u>

Foster Wheeler Environmental will evaluate and assess the risk to the environment posed by the Cornell-Dubilier Site. This evaluation and assessment will be in accordance with the ERAGS requirements (USEPA 1997) and presented in the Ecological Risk Assessment Report. Consistent with the above guidance, a SLERA will be performed to assist in focusing the investigation in preparation of the baseline evaluation. It is anticipated based upon review of historical

documentation and the Draft USEPA Ecological Risk Assessment that sufficient historical data exists to perform the SLERA during the Phase I investigation. The SLERA will be included in the Data Evaluation Report (see Section 3.6.4) and will present the final objectives and data needs for preparing the BERA. Principal elements addressed in these reports are presented in the subsections that follows.

3.7.2.1 Screening Level Ecological Risk Assessment Report

Consistent with the ERAGS guidance, Foster Wheeler Environmental will prepare a Draft SLERA Report as part of the Data Evaluation Report for the Site that addresses Steps 1 and 2 of ERAGS. This report will form the basis for documenting the initial evaluation of ecological risks from the Site, adjacent areas of the Bound Brook flood plain, and New Market Pond.

The SLERA will describe the environmental setting and preliminarily determine if ecological receptors are exposed to and potentially at risk as a result of exposure to contaminants at the Site, the Bound Brook flood plain and New Market Pond. The SLERA will provide a preliminary estimate of risk for consideration at the first Scientific Management Decision Point (SMDP #1), provide the basis to determine the need for the performance of a complete BERA (i.e., ERAGS Steps 3 through 7) and assist in identifying the assessment and measurement endpoints for the BERA. Evaluation of historical studies and reports provided by the USEPA and the USEPA Environmental Response Team will be used in developing the SLERA. Based upon preliminary review of the available data and the draft risk evaluation prepared by the USEPA ERT, it is anticipated that the Site will require a BERA. The SLERA will allow for evaluation of data gaps or needs in defining the final scope of work for the BERA. This scope of work will be conducted during the Phase II investigation.

3.7.2.2 Draft Baseline Ecological Risk Assessment Report

Foster Wheeler Environmental will prepare a Draft BERA Report for the Site that addresses the following:

- Problem Formulation and Hazard Identification Foster Wheeler Environmental will review available information on the hazardous substances present in the Site soils and identify the major Contaminants of Potential Ecological Concern (COPECs) as part of the problem formulation for the site.
- Toxicity Evaluation and Dose-Response Assessment The COPECs will be selected based on their intrinsic toxicological properties as evaluated from the available toxicological literature.
- Characterization of Potential Receptors Environmental exposure pathways end receptor populations potentially affected will be characterized and verified.
- Assessment and Measurement End Points Representative COPECs, receptor species (i.e., species especially sensitive to environmental contaminants), and assessment and measurement end points to focus on will be identified.

- Toxicity Assessment/Ecological Effects Assessment A toxicity and ecological effects assessment will be performed to identify the potential adverse environmental effects associated with chemical exposures, the relationships between the magnitude of exposures and adverse effects, and the related uncertainties for contaminant toxicity (e.g., weight of evidence for a chemical's toxicity).
- Site Conceptual Model A conceptual model of the Site will be developed and presented based on the contaminants identified, the exposure and toxicity assessments, and the risk characterization.
- Exposure Assessment An exposure assessment will be performed to identify the magnitude of actual or potential environmental exposures, their frequency of occurrence and duration, and the routes of exposure for the environmental receptors. This assessment will include the likelihood of occurrence, which will provide the basis for developing acceptable exposure levels, and reasonable maximum exposure estimates for current land use conditions at the Site.
- Risk Characterization Chemical-specific toxicity information, combined with quantitative and qualitative data from the exposure assessment, will be compared to measured contaminant exposure levels and the levels predicted through environmental fate and transport modeling. These comparisons will be utilized to determine if concentrations of soil contaminants at or near the site are affecting or could potentially affect ecological receptors.
- Identification of Limitations/Uncertainties Critical assumptions (e.g., background concentrations and conditions) and uncertainties stated in the report will be discussed with respect to their impact on the risk characterization.

Focus and preparation of the BERA will rely upon results of the SLERA evaluation of available historical data, media sampling as part of the current RI/FS investigation, and Site-specific ecological characterization studies performed as part of the Reconnaissance and Phase I investigations proposed in Section 3.6. Historical reports and data collected from the Site and the Bound Brook floodplain will be utilized to the greatest extent possible to streamline the BERA problem formulation and data needs analysis, in focusing field efforts for defining the assessment and measurement endpoints.

In the absence of reviewing the historical benthic macroinvertebrate and fish community reports, which have not yet been received by Foster Wheeler Environmental, field studies to acquire this information will be incorporated into the scope of services for preparation of the BERA. Results of media sampling in conjunction with the ecological characterization studies will be evaluated and incorporated into the BERA for the Site. Should review of the historic USEPA ERT reports on the Bound Brook and New Market Pond benthic and fish community health be deemed acceptable for inclusion as part of the BERA, these subtasks will be re-evaluated for their focus or need in lieu of the available historical data and studies as part of the Phase II Work Plan Addendum.

3.7.2.3 Final Baseline Ecological Risk Assessment Report

After the Draft BERA Report has been reviewed and commented on by USEPA, Foster Wheeler Environmental will submit a written response to each comment to the USEPA for review. Any further resolution/clarification of specific comments or Foster Wheeler Environmental's responses will be rectified with the USEPA prior to revising the draft report.

Once required revisions are finalized and agreed to by USEPA, Foster Wheeler Environmental will revise the Draft BERA Report as warranted and submit a Final BERA Report to USEPA. In addition, upon acceptance by USEPA, an electronic copy of the Final BERA Report will be submitted in HTML format to the USEPA Records Manager.

3.8 TASK 8 - TREATABILITY STUDY AND PILOT TESTING

Three levels of treatability studies are generally available to assess remedial technologies - laboratory screening, bench-scale testing, and pilot-scale testing. Laboratory screening is used to assess the validity of a technology to treat a specific waste, while bench-scale testing is used to assess the performance of a technology for a specific waste. Both laboratory screening and bench-scale testing are typically performed during the Feasibility Study (FS). Pilot testing is used to provide quantitative cost, performance and design data for a technology, and may also be performed during the FS, or as a pre-design investigation.

Due to the limited data currently available, it is unknown whether treatability studies or pilot testing will be necessary to effectively evaluate remedial technologies for the Site. Upon receipt of analytical data from the environmental samples collected during the Reconnaissance, Phase I and Phase II investigations, a literature search will be performed. Based on the findings of the literature search, a determination will be made if treatability studies and/or pilot testing should be performed to determine the suitability of remedial technologies to site conditions and provide adequate data for cost estimating and performance capabilities.

3.8.1 Literature Search

Upon receipt of analytical data from the Reconnaissance, Phase I and Phase II investigations, Foster Wheeler Environmental will perform a literature search to compile a list of applicable remedial technologies based on the Site conditions (e.g., contaminants, physical constraints, geology, etc.). The results of the literature search will be summarized in a Technical Memorandum submitted to USEPA. The memorandum will also provide Foster Wheeler Environmental's recommendation as to whether laboratory screening, bench-scale testing and/or pilot-scale testing should be performed on one or more of the identified technologies.

3.8.2 <u>Treatability Study Work Plan</u>

Upon receipt of USEPA's concurrence with Foster Wheeler Environmental's recommendations for treatability and/or pilot studies, a Treatability Study Work Plan will be prepared and will include, but not be limited to, descriptions of the following:

- Technologies to be tested
- Test objectives
- Test equipment or systems
- Experimental procedures
- Treatability conditions to be tested
- Pilot plant installation, startup, operation and maintenance procedures and operating conditions to be tested (if pilot-scale studies are required)
- Measurements of performance
- Data quality objectives
- Analytical methods
- Data management and analysis
- Health and safety procedures
- Residual waste management
- Permitting requirements (for any off-site activities)

A Draft Treatability Study Work Plan will be submitted after receipt of USEPA's concurrence with the recommendations in the Literature Review Technical Memorandum. The Treatability Study Work Plan will include a schedule of activities that identifies all major tasks and subtasks (milestones) for performance of the treatability studies, including USEPA reviews. The Treatability Study Work Plan will, to the maximum extent possible, reference the Site-specific QAPP and EHS Plan.

A Final Treatability Study Work Plan, incorporating USEPA comments, will be submitted after receipt of USEPA's final comments on the Draft Treatability Study Work Plan.

3.8.3 Conduct Treatability Studies

Upon receipt of USEPA approval of the Final Treatability Study Work Plan, the treatability studies will be conducted in accordance with the approved Work Plan and schedule. Performance of the treatability studies will include, but not be limited to, the following activities:

- Providing test facilities and all equipment necessary for performance of the approved treatability studies;
- Testing and operating the equipment in accordance with the approved Work Plan;
- Obtaining all necessary samples in accordance with the approved Work Plan;
- Performing field or laboratory analysis of samples, as specified in the approved Work Plan (if laboratory analysis is required, an outside laboratory will be procured to provide fastturnaround analysis of samples); and
- Characterizing and disposing of all residuals generated during the treatability studies.

3.8.4 Treatability Study Report

Foster Wheeler Environmental will submit a Treatability Study Report after completion of the treatability tests in accordance with the Treatability Study Work Plan. The report will describe the performance of each technology tested and compare the performance to both predicted performance and performance standards established for the site. The report will summarize the effectiveness,

implementability of each technology, and evaluate full-scale implementation of the technology, including performance of a sensitivity analysis for key parameters that may affect full-scale operation and effectiveness. Foster Wheeler Environmental will submit only one version of the Treatability Study Report.

3.9 TASK 9 - REMEDIAL INVESTIGATION REPORT

Foster Wheeler Environmental will collect environmental data required to determine the key contaminants of concern at the Site, to accurately establish the media contaminated, and to determine the horizontal and vertical extent of the contamination. Key contaminants will be selected on the basis of their persistence and mobility in the environment and by their degree of hazard to human and/or environmental receptors. These key contaminants will be evaluated for receptor exposure and an estimate of the contaminant levels reaching human or environmental receptors will be made. Existing standards and guidelines (e.g., drinking-water standards, water- quality criteria, and other criteria accepted by the USEPA as appropriate for the situation) will be used for comparison with Site data to evaluate potential effects to human receptors.

3.9.1 Draft Remedial Investigation Report

Foster Wheeler Environmental will submit a Draft Remedial Investigation (RI) Report pursuant to the RI/FS schedule presented in this Work Plan. The Draft RI Report will include, but will not be limited to, the following major categories:

- Site Background
- Investigation
- Site Characteristics
- Nature and Extent of Contamination
- Fate and Transport
- Summary and Conclusions

The Risk Assessment Reports (see Section 3.7) will be referenced and included as appendices.

Additional detail regarding the content and presentation requirements for each category is presented in the following sections.

Site Background

Summaries will be provided of available regional and Site-specific information, including physical features, demographic information, current and historical land uses, cultural resources, and current or historic environmental investigations. These summaries may include the following:

- An index map showing where the Site is located within the State of New Jersey.
- A regional map showing the location of the Site relative to nearby cultural or ecological features such as: residential, commercial and industrial areas; public water supply wells; schools; parks; wetlands; surface water bodies; other hazardous waste sites; etc.

- A Site map (or maps) showing the locations of all present and historic structures and other pertinent features. Labels or a key will be used to explain the nature of each Site feature. More than one map may be necessary to adequately represent operational changes over time.
- A topographic contour map presented at a sufficiently large scale (e.g., 1" = 20') and detail to allow sample locations to be plotted accurately in relation to Site features. This may require that the Site be divided into a number of maps to provide a sufficient level of detail. A smaller-scale index map will be provided to show the locations of the large scale maps relative to the entire Site.
- Definitions of current and past hazardous materials practices at the Site. This will include a list of chemicals and hazardous materials produced, used, stored or disposed of at the Site, as well as discussions of known methods of waste disposal.
- References to and summaries of all previous environmental studies and investigations involving the Site. These summaries will include discussions of the reasons for the investigation as well as the key findings. Relevant data summaries, e.g., chemical analyses, contaminant plume maps, etc., will be provided either within the RI Report text or in appendices. The types of media that were analyzed, sampling dates, analytical parameters, and method detection limits for "non-detect" results will be provided, along with a summary of any significant sampling- or laboratory-related QA/QC problems. The parties responsible for all sampling and analytical events will also be identified.
- A map showing the location of all previous environmental sampling locations. In the
 event that locations are approximate (e.g., if they are determined from a written
 description or graphically transferred from an existing figure), this uncertainty will be
 noted.
- A discussion of the federal, state and local regulatory history of the Site. This discussion will include references to pertinent correspondence, court orders, or other relevant documents relating to regulatory actions pertaining to the Site. A table may be used to summarize the regulatory history.
- The findings, if available, of USEPA's aerial photograph analysis provided in the Environmental Photographic Interpretation Center (EPIC). The EPIC findings may be summarized in the RI Report text and/or included as an appendix.
- Ecological concerns such as sensitive habitats, wetlands, or threatened or endangered species.

Investigation

This portion of the RI report will provide the scope for or otherwise address the following major investigative topics:

- Field Investigation and Technical Approach
- Chemical Analysis and Analytical Methods
- Field Methodologies
- Biological Assessment
- Surface Water
- Sediment
- Soil Boring

- Monitoring Well Installation
- Groundwater Sampling
- Hydrogeological Assessment
- Air Sampling
- Building Interior Sampling

Well, Soil Boring and Test Pit Logs

Graphical soil boring and test pit logs will be prepared to describe the subsurface conditions encountered during intrusive operations. In developing final logs from rough field logs, there will be no attempt to simplify the logs by eliminating data or observations obtained in the field. If necessary, additional pages will be included to explain any drilling problems, unusual observations, detailed stratigraphic descriptions or any other information that would help to convey how the boring was installed and the nature of the subsurface conditions that were encountered, but will not fit into the standard boring log format.

Elevations for ground level and top of casing will be given relative to mean sea level. Locations will be given in the New Jersey State Plane coordinate projection, using the NAD 1983 horizontal datum. A short verbal description of the well, soil boring and test pit locations will also be provided, e.g., "50 feet south of Building 18."

The well/boring installation methods and materials will be summarized on the well/boring log and/or well construction diagram. Precise descriptions will be provided for all cements, grouts, filter packs, seals, etc., including specific compositions, trade names, depths of placement and any other pertinent details. The volumes of materials used in the construction of a well will also be reported. For wells installed using mud rotary techniques, an estimate of the amount of mud lost to the formation will be reported.

Well development procedures will be documented for each well. This information may be included on the well construction diagram or accompanying pages. Information recorded will include calculations of well and filter pack volume, development method or methods employed (e.g., surge and pump), the type of pump used, pumping rate, total volume of water removed from the well, duration of well development, and any water quality parameters (e.g., turbidity, temperature, conductivity, pH) measured during the well development.

Well purging information for each well will be documented for each groundwater sampling event. Well purging and groundwater sampling will be conducted following the USEPA low flow procedure. Information recorded on the well sampling logs will include well number, water level, well depth, sampling personnel, data, pump intake depth, pump flow rate, PID/FID readings, and any additional notes/observations. All water quality parameters measured to determine when steady-state conditions have been achieved will also be recorded on the well purge logs to be included as an appendix of the RI Report.

Geophysical Investigation Results

Maps will be prepared to show the locations of the geophysical stations/traverse lines and their relationship to potential contaminant source areas.

All details relating to the types of geophysical instruments employed, to their calibration and use in the field (e.g., traverse spacing, QA/QC measurements, interferences, etc.) or to potential impacts to the interpretation or utility of the geophysical data (e.g., solar/magnetic storms) will be reported.

All raw, uninterpreted data used to support document conclusions will be provided in the appendices, along with a complete explanation of how the data were manipulated/corrected in developing the geophysical conclusions. A surveyor's report will also be included with the raw data if the geophysical stations or traverse lines are surveyed.

The effective depth of exploration and limitations for each geophysical method will be discussed. This discussion will include any requisite supporting calculations.

The geophysical survey results will include discussion of the possible cause of all significant geophysical anomalies and their relationship to known or suspected contaminant source areas. Anomalies that correspond to sharp topographic changes or other known interferences will be identified and explained. An attempt will be made to correlate geophysical data with other data available for the Site.

Conditions Warranting Immediate Removal Action

It is possible that during the course of the field investigation, conditions that warrant an immediate removal action may be discovered. Examples of this type of situation include leaking drums, leaking underground or aboveground storage tanks, a liquid-filled lagoon with a weakened berm, potentially explosive conditions, and evidence of contaminated drinking water wells. As much detail as possible will be provided in the report so that the feasibility of conducting an immediate removal action can be evaluated.

Site Characteristics

The RI report will include discussion of the following:

- Geology
- Hydrogeology
- Meteorology
- Demographics and Land Use
- Ecology

Regional Hydrogeological Framework

Development of the regional hydrogeological framework will begin with a review of available USGS, USDA, and State of New Jersey bulletins or publications that include information for the area of interest. If regional geologic, surface soil, aquifer thickness, or groundwater elevation maps are available through these agencies, the relevant portions will be reproduced in the report along with

their associated legends and/or explanations, and will be properly referenced. The information presented in this section will focus on information directly relevant to the Site. For example, minimal discussion will be devoted to the overall depositional history of the Newark Basin sediments, since the Brunswick Formation is the only bedrock aquifer formation hydraulically associated with the Site.

Discussions will focus on characterizing those factors that may control or impact groundwater flow patterns and/or groundwater quality, and on how physical characteristics of the regional hydrogeologic framework relate to Site-specific contamination problems. Regional patterns of groundwater extraction by public and private wells, and the potential effects on contaminant migration patterns will be discussed. All statements or information regarding regional hydrogeology will be appropriately referenced.

Site Hydrogeological Framework

Development of the Site hydrogeological framework will be based primarily upon Site-specific information. This framework will describe the heterogeneity of both the unconsolidated aquifer (if present) and the fractured bedrock aquifer, and will address the extent to which this investigation assessed such heterogeneity. This framework will be described in descriptive terms based upon subsurface sediment/lithologic characteristics, groundwater quality information, and potentiometric data. Only data collected during the present RI or during an earlier investigation performed under federal or state oversight will be used to support critical parameters in the conceptual hydrogeologic framework. All primary supporting information, e.g., well logs, soil boring logs, test pit logs, pumping test results, calculations of hydraulic parameters, etc., will be included in the report appendices. Accurate geologic cross sections will also be developed.

If it is suspected that the bedrock surface influences groundwater flow patterns and/or contaminant migration, a structure contour map of the top of bedrock may be developed. This situation may result, for example, if the bedrock surface is sufficiently weathered to result in a lower permeability zone that acts as a semi-confining unit. However, such weathered zones, or glacial tills or even clay layers, will not be assumed to represent confining layers, since fractures can provide efficient pathways for contaminant migration.

It will not be assumed that groundwater discharges completely to the Bound Brook. The piezometric surface of the bedrock aquifer will be measured in wells located near the stream and compared to surface water elevation. Surface water flow, precipitation rates, and evapotranspiration rates will then be determined to support a mass balance calculation to determine whether such an assumption is valid.

A brief summary of the hydrogeologic framework for the Site will be provided to the USEPA for review prior to development of this section of the Draft RI Report. This will allow any questions regarding the number of aquifer units, the presence or absence of confining units, and the direction of groundwater flow to be resolved before numerous maps, tables and figures are developed.

Potentiometric Contour Maps

A potentiometric map will be developed for the bedrock aquifer, with all elevations/potentiometric values being expressed relative to mean sea level elevations. The base map used to develop these maps will show topographic contours, roads, surface waters, drainage features, the Site boundary, and known or potential source areas for groundwater contamination. This map will also show immediately adjacent commercial and residential areas and any other significant cultural features, e.g., the Lehigh Valley Railroad which borders the Site to the northeast.

Individual maps will represent only one round of groundwater level measurements, with the date and time during which the measurements were obtained included in the title block of the map. Surface water elevations in the Bound Brook will also be measured during the same event, and the measurement location will be shown on the map. A table will be used to provide the exact time that each groundwater/surface water level measurement was made, the depth to water from the measurement point, the elevation of the groundwater relative to mean sea level, and the surveyed elevations of the measurement point (generally the top of casing) and the ground surface at the well. Wells used for a given potentiometric map will be indicated with a larger or bolder symbol so that it is clear which wells were used to constrain the mapped contours. The measured groundwater elevation will also be posted in bold type adjacent to each well location. Groundwater elevation data from wells for which no well log descriptions and/or construction logs are available will not be used to constrain a potentiometric map.

Nature and Extent of Contamination

This section of the RI Report will be divided into two major subsections: contaminant sources, and contaminant distribution and trends.

- Contaminant Sources A full description of all potential contaminant source areas within the
 investigated area will be provided, utilizing all current and available pre-existing
 information. These discussions will include the following points: dimensions, depth below
 grade, depth to water table, waste volume, type of wastes/products, construction/
 demolition/closure dates, regulatory history, past/existing permits, historical changes in use
 or configuration, and available environmental sampling results.
- Contaminant Distribution and Trends A full discussion of the horizontal and vertical extent of contamination in all Site media will be presented.

Discussions of the nature and extent of contamination will focus on those contaminants that pose the most significant risk to human health and the environment and exceed state or federal Applicable or Relevant and Appropriate Requirements (ARARs), not necessarily those that are present at the highest concentrations. For example, iron and calcium may be present at elevated concentrations; however, these constituents are unlikely to result in the greatest risk.

Recent and historic sampling results will be quantitatively compared to sampling results from the RI investigation, only when the same or equivalent sample collection methods, analytical methods,

QA/QC protocols, etc. were employed. If different methods, protocols, etc. were used, only qualitative comparisons will be made.

Physical and chemical properties of contaminants (e.g., density, solubility and mobility) exert significant effect on their distribution in the environment and their patterns of transport. Therefore, pertinent physical and chemical properties of Site-related contaminants will be summarized in a table. Assumptions will not be made regarding the valence state of inorganic contaminants if only "total" analyses have been performed. Relative solubilities of contaminants may also control the levels at which they occur in groundwater or surface water, and concentrations of particular groundwater contaminants will be compared to their solubilities. If a groundwater contaminant's concentration exceeds one percent of its effective solubility limit, the potential presence of a non-aqueous phase liquid source is indicated. If a groundwater contaminant's concentration exceeds its solubility limit, a pure phase product exists either as a layer or in colloidal form.

The potential for a layer of dense non-aqueous phase liquid (DNAPL) will be addressed, since TCE is a known Site contaminant. The quantity of pure liquid phase TCE disposed of or spilled at the Site is unknown. As TCE is denser than water, care will be taken to determine whether a layer of product is present at or near the overburden/bedrock interface.

Site-specific background levels will be determined for soil, groundwater, surface water and sediment using information that relates directly to the Site locale. This information will include the results of sampling and analyses conducted in the vicinity of the Site. Due to natural variations in levels of inorganics and other constituents in soils, soil collected in background locations will be of the same type as the contaminated soil in the areas under investigation. Additional background information may potentially include location-specific data from sources such as the USGS, USDA and New Jersey Geological Survey. A table will be used to summarize the background levels for the Site.

Isocentration maps of Site-related contaminants will be used to summarize the RI sampling results, and will illustrate the level and current extent of Site-related contamination and may also illustrate potential future migration pathways. In addition, information from groundwater isoconcentration maps (and cross sections if samples are collected from multiple depths) may be used to support decisions regarding the need for additional monitoring wells, the threat to off-site groundwater sources, and the scope of potential groundwater remediation. All applicable sampling information will be used in the development of the isoconcentration contour maps. Factors such as sampling and analytical protocols, well construction details, and screened intervals will be considered when comparing RI sampling results to sampling results from other sources. Different symbols will be used to distinguish wells that were not installed by Foster Wheeler Environmental during the RI investigation.

All residential or public water supply wells and/or surface water discharge points will be indicated on the contaminant isoconcentration maps. If important public water supply or industrial wells lie outside the area represented by the map, annotations will be placed in the margins that indicate their distance and direction from the map boundary.

All indicators of the probable extent of the groundwater contaminant plume will be considered when developing the isoconcentration maps. These indicators may include, but are not limited to,

geophysical survey results, contaminant source locations, historical information, borehole descriptions of contamination below the water table, subsurface soil sampling results, and the direction of groundwater flow. These contour maps may be generated using a computer program such as Quicksurf®, which is included in GIS\Key®, the data management/GIS platform selected by Foster Wheeler Environmental for this project. Control points may be entered into GIS\Key® to allow incorporation of professional judgement to consider indicators such as those mentioned above. The degree of confidence in various portions of an isoconcentration map will be indicated by using solid lines (high confidence), dashed lines (low confidence), and dotted lines or question marks (very low confidence).

The number and types of isoconcentration plots, e.g., maps and/or cross sections, required will depend on the nature of the Site contamination. Development of isoconcentration plots will be considered for any Site-related contaminant (e.g., TCE) or contaminant class (e.g., total PCBs) that exceeds ARARs and/or poses a relatively high risk to human health or the environment.

Fate and Transport

This section of the RI report will address three major issues.

- Contaminant Characteristics
- Transport Processes
- Contaminant Migration Trends

A qualitative assessment of the environmental fate and transport of Site-related contaminants will be conducted on the basis of individual constituents, with the discussions grouped by contaminant class. In addition to consideration of the physical-chemical transport properties for individual constituents, this assessment will consider the potential for cosolvent effects on mobility. Site-specific properties of the environmental media will also be considered, including factors such as soil and groundwater pH, redox potential, and the effects of colloidal transport.

Summary and Conclusions

This section will focus upon integration of all available information to develop a comprehensive understanding, or "conceptual model," of the Site. As such, development of the conceptual model will require comparison of information derived from multiple sources, both current and historic, and from sampling and analysis of various environmental media, e.g., source materials, surface and subsurface soils, groundwater, etc. The intent will be to describe the current state of understanding of the link between the nature and magnitude (volume and mass) of source contamination, the applicable contaminant transport mechanisms, and the current nature and extent of Site-related contamination. The summary will include an assessment of the limits of understanding, so that recommendations for additional sampling may be made to eliminate any critical data gaps. This model can then be used to predict future contaminant migration and to support decisions regarding remedial actions.

General Report Preparation Guidelines

The following guidelines will be used in preparing the Draft Remedial Investigation Report:

Figure Guidelines

- The original source of each figure will be referenced. If a pre-existing figure is modified, the new figure shall reference both the pre-existing figure and its original source.
- The area of interest will be enlarged to fill as much of the available space on the page/plate as possible.
- All units, symbols, patterns, and scales used on figures will be fully explained in a key provided on the figure.
- Whenever possible, key figures/tables will be inserted in the text following the page on which they are first referenced.
- All text and symbols used on maps, tables and figures will be legible. To avoid data loss during reproduction nothing in a original shall be smaller than 17 characters per inch (CPI).
- Page numbers will be given to figures so that they can be easily located or replaced in the text.
- Well identification numbers will indicate the depth interval or hydrogeologic zone that they are screened in. The designation of depth zones and well identification numbers shall be consistent throughout the various phases of the RI investigation.
- Residential wells will be referred to by an alpha-numeric system. A table shall be included
 which provides the street address and any construction/operational information on these
 wells. Family names shall not be used to refer to residential wells because property
 owners/renters can change.

Map Format

- All maps will include an accurate north arrow, scale, a title explaining the purpose of the map, and an explanation of all symbols/notations.
- The scale will include both a written scale and a graphical scale. The inclusion of a graphical scale is essential because its accuracy will be retained even if the map is enlarged or reduced through reproduction processes.
- At least one base map with an appropriate map scale (e.g., 1 inch equals 50 feet, 1 inch equals 100 feet) will be utilized to accurately show the location of environmental sampling locations relative to known source areas, topographic contours, Site boundary and other important features.

- The surveyor's reference point/benchmark will be identified on the map.
- Text and numbers will be oriented on the map so that the north arrow is pointing in an upward direction as one reads the map. The orientation of text and numbers relative to north will be consistent from map to map throughout the report.
- All units, symbols and patterns used on the map will be fully described in an explanation included on the map. For groundwater elevation or contaminant isoconcentration maps, the explanation will state exactly how the mapped values were derived. In addition, as applicable, the date that the data was collected will be indicated.
- The map title and figure/plate number will be shown in large bold type.
- Maps will either be presented in a digitized Arc Info or GIS format, as specified by the USEPA.

Presenting Analytical Results

- Tables of analytical results will be organized in a logical manner (e.g., by sample location number, sampling zone, etc.). For example, groundwater sampling results may be separated by location (upgradient, on-site, downgradient), by hydrogeologic framework (overburden aquifer, bedrock aquifer) or by a combination thereof (on-site overburden aquifer, upgradient bedrock aquifer). Surface/subsurface soil analyses may be separated according to site location or specific contaminant source/background areas.
- The sample location/well identification number shall always be used as the primary reference for the analytical results. Analytical results will not be ordered by laboratory identification numbers.
- Analytical tables will indicate the sample collection dates.
- The detection limit will be indicated in instances where a parameter was not detected.
- Analytical results will be reported in the text, tables and figures using a consistent convention, such as ug/L for groundwater analyses, ug/kg for organic soil analyses, and mg/kg for inorganic soil analyses.
- The applicable federal/state criteria for each constituent will be specified on the analytical tables, and exceedances of criteria will be highlighted. Any samples where the detection limit is greater than the applicable criteria will be identified, and an explanation will be provided.

Discussion of Laboratory/Field Blank Contamination

• Discussion of approved sampling results shall not be qualified by suggesting that a particular chemical is a common laboratory contaminant or was detected in a laboratory blank. If the

reported result was validated utilizing the criteria presented in Section 3.5.3, it shall be considered valid and usable.

• Results from field equipment rinsate blank analyses will be discussed, as necessary, if decontamination solvents are believed to have contaminated field samples.

3.9.2 Final RI Report

After USEPA review of the Draft RI Report, Foster Wheeler Environmental will incorporate final USEPA comments and submit a Final RI Report.

3.10 TASK 10 - REMEDIAL ALTERNATIVES SCREENING

Following submittal of the Final RI Report, Foster Wheeler Environmental will develop appropriate remedial alternatives to undergo full evaluation. A range of alternatives will be developed, including a No Action alternative, a containment alternative that involves little or no treatment, and a number of treatment alternatives that encompass both currently accepted and innovative technologies.

All alternatives will be developed consistent with the NCP, "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA," "Considerations in Ground Water Remediation at Superfund Sites," and any more recent guidance, policies or procedures applicable to remediation activities performed under CERCLA. Alternatives will only be developed to address contaminated media remaining at the Site as determined during the RI.

3.10.1 <u>Draft Remedial Alternatives Technical Memorandum</u>

After submission of the Final RI Report to USEPA, a Draft Remedial Alternatives Technical Memorandum will be submitted that will identify the potential remedial alternatives developed for the Site. The memorandum will summarize the following information, which will be presented in detail in the FS Report:

- Establishment of Remedial Action Objectives (RAOs) Based on the findings presented in the RI, RAOs will be developed to protect human health and the environment. The RAOs will specify the contaminants and media of concern, exposure routes and receptors, and acceptable contaminant levels or ranges for each exposure route (i.e., preliminary remediation goals as established in the Risk Assessment Reports).
- Establishment of General Response Actions General Response Actions (GRAs) will be established for each media of concern at the site, taking into consideration the physical and chemical characteristics of the Site and the RAOs. GRAs to be considered include: "No Action," institutional controls (e.g., use restrictions, etc.), containment, and treatment.
- Identification and Screening of Applicable Remedial Technologies For each of the GRAs developed for each media of concern, remedial technologies/process options will be identified and screened to select those technologies/process options that are applicable to the conditions and contaminants present at the Site. The screening is based primarily on the

effectiveness of the technology/process option to address the contaminants of concern; however, implementability and cost are also factored into the screening. Although a number of process options for a given technology type may be retained during the screening, a single process option considered representative of the technology type will be identified for alternative development. Although it is anticipated that treatability study requirements will have been identified earlier (see Task 8), and treatability studies may have already been performed in parallel with the Phase II investigation, any additional treatability study needs will be identified during the screening of technologies.

Development of Remedial Alternatives - Remedial alternatives will be developed by combining remedial technologies or representative process options into overall remedial alternatives (media-specific), in accordance with the requirements of the NCP. Remedial alternative descriptions will include size and configuration of selected techniques/process options, estimated time for remediation, flow rate or treatment rate, spatial requirements, disposal requirements including distances for disposal, permitting requirements, technical or administrative limitations and other factors that may affect the overall performance of the alternative. If a large number (e.g., greater than 5) of viable potential remedial alternatives are developed for a specific media, a preliminary screening of alternatives will be performed using the general criteria of effectiveness, implementability and cost to reduce the number of alternatives to be combined into site-wide alternatives and carried forward for detailed evaluation. The effectiveness screening will consider the capability of each remedial alternative to protect human health and the environment. Each alternative will be evaluated as to the protection it would provide, and the reductions in toxicity, mobility, or volume of contaminants it would achieve. The implementability screening will be used to measure both the technical and administrative feasibility of constructing, operating, and maintaining the remedial alternative. In addition, the availability of the technologies involved in a remedial alternative will be considered. Innovative technologies will be considered throughout the screening process if there is a reasonable belief that they offer a potential for better treatment performance or implementability, few or lesser adverse impacts than other available approaches, or lower costs than demonstrated technologies. Cost screening will include estimates of capital costs, annual operation and maintenance (O&M) costs, and present worth analysis. These conceptual cost estimates are order-of-magnitude estimates.

3.10.2 Final Remedial Alternatives Technical Memorandum

A Final Remedial Alternatives Technical Memorandum, incorporating final USEPA comments on the Draft Remedial Alternatives Technical Memorandum, will be submitted.

3.11 TASK 11 - REMEDIAL ALTERNATIVES EVALUATION

The remedial alternatives that pass the initial screening will be subject to detailed evaluation against nine evaluation criteria. Following the individual evaluation of each of the alternatives relative to the nine criteria, a comparative analysis between alternatives will be performed. Both the individual and comparative analyses will conform to the requirements of the NCP, the "Interim Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988) and other applicable guidance. Brief descriptions of the nine evaluation criteria are provided below:

Short Term Effectiveness

This criterion addresses the effects of the alternative during the construction and implementation phase until the remedial alternatives have been constructed. Each alternative is evaluated with respect to its effects on the community and on-site workers during the remedial action, environmental impacts resulting from implementation, and the amount of time until protection is achieved.

Long Term Effectiveness

This criterion addresses the results of a remedial action in terms of the risk remaining at the Site after the response objectives have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The factors to be evaluated include the adequacy, suitability, and long-term reliability of management controls for providing continued protection from residuals (i.e. assessment of potential failure of the technical components).

Reduction of Toxicity, Mobility, or Volume

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the contaminants. The factors to be evaluated include the treatment process employed, the amount of hazardous material destroyed or treated, the degree of reduction expected in toxicity, mobility, or volume, and the type and quantity of treatment residuals.

Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Technical feasibility considers construction and operational difficulties, reliability, ease of undertaking additional remedial action (if required), and the ability to monitor its effectiveness. Administrative feasibility considers activities needed to coordinate with other agencies (e.g. state and local) in regard to obtaining permits or approvals for implementing remedial actions.

Cost

This criterion addresses the capital costs, annual operation and maintenance costs, and present worth analysis.

Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include expenditures for the equipment, labor, and material necessary to perform remedial actions. Indirect costs include expenditures for engineering, financial, and other services that are not part of the actual installation activities but are required to complete the installation of remedial alternatives. Annual operation and maintenance costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. These costs will be estimated to provide an accuracy of +50 percent to -30 percent.

A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money that would be sufficient to cover all costs associated with the remedial action over its planned life. As suggested in the USEPA's guidance (1988), a discount rate of five percent will be considered unless the market values indicate otherwise during the performance of the FS.

Compliance with ARARs

This criterion is used to determine how each alternative complies with applicable or relevant and appropriate federal and state requirements, as defined in CERCLA Section 121.

Overall Protection of Human Health and the Environment

This criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

State Acceptance

This criterion evaluates the technical and administrative issues and concerns the state may have regarding each of the alternatives. The factors to be evaluated include those features of alternatives that the state supports, reservations of the state, and opposition of the state.

Community Acceptance

This criterion incorporates public concerns into the evaluation of the remedial alternatives. Typically, state and community acceptance cannot be determined during development of the FS. Evaluation of these criteria is postponed until the FS has been released for review to the state and public. These criteria are then addressed in the responsiveness summary and the ROD.

3.11.1 <u>Draft Remedial Alternatives Evaluation Memorandum</u>

Foster Wheeler Environmental will prepare and submit, subsequent to the Final Remedial Alternatives Technical Memorandum, a Draft Remedial Alternatives Evaluation Memorandum that will provide a technical description of each alternative that was retained for detailed evaluation following the initial alternative screening. The memorandum will include identification of key ARARs associated with each alternative and a summary of the performance of each alternative with respect to the evaluation criteria. The memorandum will also include a summary of a comparative analysis between alternatives with respect to the evaluation criteria. As discussed previously, only data on seven of the criteria is likely to be available for presentation in the memorandum (state and community acceptance will be documented subsequent to the FS).

3.11.2 Final Remedial Alternatives Evaluation Memorandum

A Final Remedial Alternatives Evaluation Memorandum, incorporating USEPA comments, will be submitted after receipt of USEPA's final comments on the Draft Remedial Alternatives Evaluation Memorandum.

3.12 TASK 12 - FEASIBILITY STUDY REPORT

The Feasibility Study (FS) Report will be prepared in this task. The FS Report will provide the detailed documentation of each step completed during the feasibility study, including a summary of the potential remedial alternatives, cost analysis, institutional analysis, public-health analysis and environmental analysis. The report will include a description of the initial screening study process and the detailed evaluations of the remedial alternatives studied. All of the information previously summarized in the technical memoranda (e.g., development of RAOs, identification of GRAs, evaluation against the nine evaluation criteria, comparative analysis of alternatives, etc.) will be presented in detail in the FS Report. As part of the detailed evaluation of the alternatives, the limitations of utilizing treatability study results will be discussed and evaluated. If the limitations are deemed too great, Foster Wheeler Environmental will recommend additional studies to be performed prior to remedial design (i.e., pre-design investigations).

3.12.1 Draft Feasibility Study Report

Foster Wheeler Environmental will submit a Draft FS Report for USEPA review subsequent to submittal of the Final RI Report. The FS Report will include an Executive Summary and four sections. The Executive Summary will be a brief overview of the study and the analysis underlying the remedial actions that were evaluated. Section 1 will summarize existing Site conditions and the nature and extent of contamination. Section 2 will include the remedial response objectives and technology screening. Sections 3 and 4 will present the screening and detailed evaluations of the alternatives, respectively. The FS Report will be prepared and presented in the format specified in "Interim Final Guidance for Conducting Remedial Investigation/Feasibility Studies under CERCLA" (USEPA, 1988).

3.12.2 Final Feasibility Study Report

A Final FS Report, incorporating USEPA comments, will be submitted after receipt of USEPA's final comments on the Draft FS Report.

3.13 TASK 13 - POST RI/FS SUPPORT

Foster Wheeler Environmental will provide community relations and other technical support during the preparation of the ROD as requested by USEPA. The majority of post RI/FS activities, including public meeting support, technical assistance during preparation of the Proposed Remedial Action Plan, repository maintenance, public notices, etc., have been included in Task 2. However, Task 2 does not include technical support during preparation of the ROD (after preparation of the Responsiveness Summary). Additional technical support that may be required during preparation of the ROD is included in this task as an FS Addendum.

3.13.1 Feasibility Study Addendum

During preparation of the ROD, a Feasibility Study Addendum may be required to incorporate state and/or community concerns into the Remedial Alternative Evaluations or to incorporate new issues or concerns that may be recognized during the public participation period and preparation of the Responsiveness Summary. The anticipated scope of work for an FS Addendum includes incorporation of additional information into alternative descriptions and/or re-evaluation of existing alternatives relative to the evaluation criteria, but does not include development or evaluation of new alternatives. Foster Wheeler Environmental will prepare and submit a draft FS Addendum for USEPA review. A Final FS Addendum will be submitted after receipt of USEPA's final comments on the Draft FS Addendum.

3.14 TASK 14 - NEGOTIATION SUPPORT

As stated in the SOW, negotiation support is typically not required in a fund-lead project such as the Cornell-Dubilier Superfund Site RI/FS. Therefore, no such support activities are included in this Work Plan. If negotiation support is requested at a later date, a Work Plan Addendum will be prepared accordingly.

3.15 TASK 15 - ADMINISTRATIVE RECORD

Foster Wheeler Environmental will submit revised deliverables in paper, electronic or other storage formats as required to assist the USEPA in updating the Administrative Record (AR) or Site file for this project.

3.16 TASK 16 - WORK ASSIGNMENT CLOSEOUT

Upon notification from USEPA that all technical work performed under this work assignment is complete, all the necessary project closeout activities will be performed as specified in the contract. These activities will include: closing out all subcontracts, preparation of a technical and financial Work Assignment Closeout Report (WACR), indexing and consolidating project records and files, and providing microfiche and archiving of documents. Further details of these activities are provided in the subsections that follow.

3.16.1 Work Assignment Closeout Report (WACR)

Final costs and LOE for all activities conducted by Foster Wheeler Environmental under this work assignment will be included in a WACR and provided as an electronic copy (WordPerfect 8 and/or Lotus 1-2-3, Release 9.0) on electronic diskette. Such costs and LOE (by P-level) will be categorized in the same detail and format as the elements contained in the Work Plan and the SOW. The WACR will be submitted to USEPA after receipt of a Work Assignment Closeout Notification from USEPA.

3.16.2 Document Indexing

Foster Wheeler Environmental will organize the work assignment files in our possession in accordance with the current approved USEPA file index structure (e.g., Administrative Record Index, EPA Superfund File Index, and/or RAC Guidelines for Closeout of Work Assignment), with the final format to be determined during the project planning process. Prior to duplication and storage, a file QA audit will be performed to ensure all file elements are present, in order, and that any duplicate or draft technical report copies are removed from the project file. A File QA Audit Report will be issued to the Foster Wheeler Environmental Project Manager noting any missing file elements or discrepancies for resolution prior to duplication, distribution and storage.

3.16.3 <u>Document Retention/Conversion</u>

All project files will be archived in accordance with Federal Records Center and contract requirements. Adherence to these requirements will be verified during the file QA audit, with any deviations noted to the Foster Wheeler Environmental Project Manager for resolution prior to final project files closeout. Subsequent to the file QA audit and resolution of all outstanding issues, the project files will be microfiched by a subcontractor and distributed and stored in accordance with RAC II requirements.

3.16.4 Package and Return Documents to Government

Immediately after finalization of the technical risk assessment documents, all background information/documents provided by USEPA during the course of the project will be returned to the USEPA WAM. A cover letter citing all documents returned will accompany these submittals.

4.0 PROJECT MANAGEMENT APPROACH

4.1 PROJECT ORGANIZATION

Foster Wheeler Environmental will provide remedial investigation and feasibility study (RI/FS) support to the USEPA for the Cornell-Dubilier Site. The project will be performed under the direction of the RAC II Program Manager, Dr. Dev R. Sachdev, Ph.D., P.E.

The Project Manager is Dr. Daniel M. Miller, Ph.D. The Project Manager has the primary responsibility for development of the RI/FS Work Plan; acquisition of scientific, engineering or additional specialized technical support; and other aspects of the day-to-day activities associated with the project. The Project Manager identifies staff requirements, directs and monitors progress, ensures implementation of quality procedures and adherence to applicable codes and regulations, and is responsible for performance within the established budget and schedule.

Assisting the Project Manager are the project task leads for the technical disciplines. They are: Ms. Lynn Niles for field operations and environmental chemistry; Dr. Emily Kennedy, Ph.D. for human health risk assessment; Mr. John Schaffer for ecological risk assessment; Mr. Thomas Fowler for geology/hydrogeology; Dr. Robert Chozick, Ph.D., P.E. for the feasibility study; Mr. Joseph Sbarra, CIH, for environmental health and safety; and Dr. Jon Gabry, Ph.D. for project quality assurance. Technical discipline leads will oversee activities related to their expertise and provide their input, as needed, to the Project Manager.

A project organizational chart is provided in Figure 4-1.

4.2 PROJECT SCHEDULE

Foster Wheeler Environmental attended an on-site visit on May 18, 1999 and project scoping and technical meetings with the USEPA on June 23, 1999, to obtain a conceptual understanding of the Site and to discuss the SOW/technical aspects associated with the project, respectively. Minutes for the scoping and technical meetings were submitted on June 25, 1999 and June 28, 1999, respectively. Based on these, a proposed project schedule was developed.

Among the agreements reached during the scoping meeting, was that a Phase II investigation would be required and that design of the Phase II investigation would follow evaluation of the results of the Reconnaissance and Phase I investigations. Foster Wheeler Environmental has therefore included the preparation of a Phase II Work Plan Addendum, along with appropriate USEPA review and approval time, in the schedule and cost estimates. Although the Phase II investigation has not been fully designed, this program will focus upon filling data gaps identified in the Data Evaluation Summary Report following receipt of the Phase I investigation results (see Section 3.6). Foster Wheeler Environmental anticipates the dominant portion of sampling required to support the BERA will be performed during Phase II. Treatability studies, if necessary, will also be designed following the Phase I data evaluation.

Table 4-1 presents the schedule of major project deliverable submittals due to the USEPA. Figure 4-2 shows the overall baseline project schedule.

300093

C\Cornell_Dub\WP.wpd

Figure 4-1
Project Organization Structure

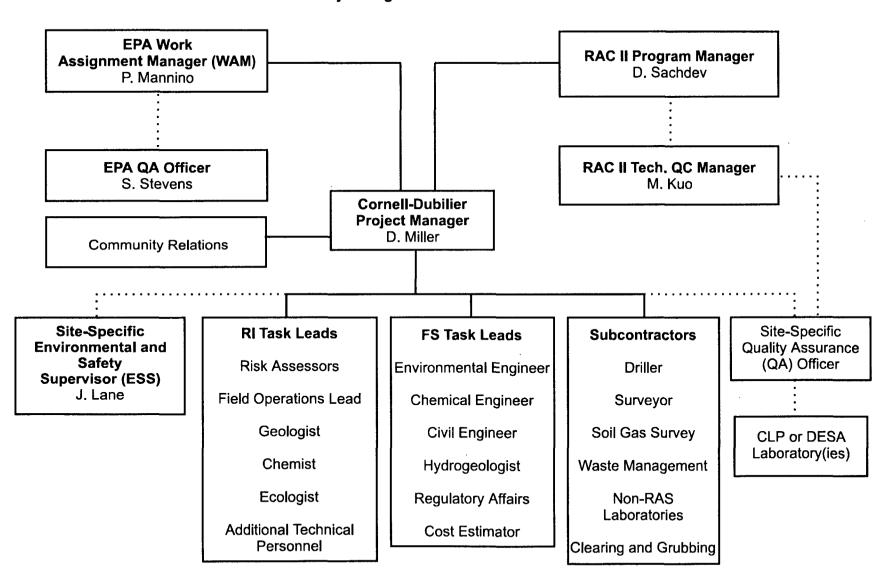


TABLE 4-1 (Sheet 1 of 2)

SUMMARY OF MAJOR DELIVERABLES FOR THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY AT CORNELL-DUBILIER

TASK	DELIVERABLE	NO. OF COPIES	DUE DATE (Calendar Days)
1.4	Draft RI/FS Work Plan	3	30 days after scoping meeting
1.7	QAPP	3	30 days after scoping meeting
1.8	EHS Plan	3	30 days after scoping meeting
1.9	Non-RAS Plan	3	Optional
1.10	Meeting Minutes	1	5 days after meeting
1.13	Pathways Analysis Report	2	30 days after scoping meeting
2.1	Community Interview Summaries	2 .	30 days after work plan approval
2.2	Draft Community Relations Plan (CRP)	2	30 days after work plan approval
2.2	Final CRP	2	14 days after final comments from EPA on Draft CRP
2.4	Fact Sheets	3	7 days prior to public meeting/event
2.6	Public Notices	3	14 days before public meeting/event
2.8	Site Mailing List	2	14 days after approval of Final CRP
5.3	Data Validation Reports	1	30 days after receipt of all analytical results from laboratory
7.1	Draft Baseline Risk Assessment Report (HH and/or Eco)	3	45 days after receipt of all validated data
7.1	Final Baseline Risk Assessment Report (HH and/or Eco)	3	14 days after receipt of EPA final comments on draft report
8.4	Treatability Study Report	3	30 days after completion of Treatability Study
9.1	Draft Remedial Investigation (RI) Report	6	120 days after receipt of all validated data
9.2	Final RI Report	6	30 days after receipt of EPA final comments on draft report

TABLE 4-1 (Sheet 2 of 2)

SUMMARY OF MAJOR DELIVERABLES FOR THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY AT CORNELL-DUBILIER

TASK	DELIVERABLE	NO. OF COPIES	DUE DATE (Calendar Days)		
10.1	Draft Remedial Alternatives Technical Memorandum	3	60 days after final RI report submission		
10.2	Final Remedial Alternatives Technical Memorandum	3	14 days after receipt of EPA final comments on draft memorandum		
11.1	Draft Remedial Alternatives Evaluation Memorandum	3	30 days after Final Remedial Alternatives Technical Memorandum submission		
11.2	Final Remedial Alternatives Evaluation Memorandum	3	14 days after receipt of EPA final comments on draft memorandum		
12.1	Draft Feasibility Study Report	3	90 days after submission of Final RI Report		
12.2	Final Feasibility Study Report	3	30 days after receipt of EPA final comments on draft report		
16.1	Work Assignment Completion Report	3	30 days after Work Assignment Closeout Notification from EPA		

Activity ID	Activity Description	Working Days	Early Start	Early Finish	Total Float	
	L-DUBILIER ELCTRONICS - WA	018-RIC	O-02GZ			
T0180100	Work Assignment Authorized	0	30MAR99*	2014 A DO2	0	
T0180101	Project Administration Site Visit	773	30MAR99 18MAY99*	29MAR02	25	5
Γ0180105	Scoping Meeting Prepare Draft Work Plan/OF60/QAPP/HASF		23JUN99* 24JUN99	23JUN99 23JUL99	0	0
	EPA Review Work Plan/OF60 Cost Estimate Negotiate Work Plan/OF60 Cost Estimate	133	26JUL99 03FEB00	02FEB00 03FEB00	0	
Γ0180111	Finalize Work Plan/OF60 Cost Estimate EPA Approval of Work Plan/OF60 Cost	35 16	04FEB00 24MAR00	23MAR00 14APR00	455 455	5
	Pathway Analysis Report	21	24JUN99	23JUL99	691	
	COMMUNITY RELATIONS Community Interview Summaries	21	17APR00*	15MAY00	455	
T0180203	Draft Community Relations Plan	21	17APR00	15MAY00	455	5
Γ0180207	EPA Review of Community Relations Plan Finalize Community Relations Plan	10	16MAY00 30MAY00	29MAY00 12JUN00	455 455	5
	Site Mailing List	10	13JUN00	26JUN00	455	5
	AISSANCE INVESTIGATION Prepare RFP's	26	04FEB00	10MAR00	0	
T0180133A	Bid Period Evaluate Proposals	15 7	13MAR00 03APR00	31MAR00 11APR00	0	
0180137A	Issue Subcontracts	10	12APR00	25APR00	0	
	Mobilization Field Investigation	3 69	26APR00 01MAY00	28APR00 03AUG00	0	
	Innovative Methods/Field Screening CLP/DESA/EPA-ERT Analysis Services	69 84	01MAY00 01MAY00	03AUG00 24AUG00	427 351	
T0180405A	Non-RAS	92	01MAY00	05SEP00	382 427	
Γ0180503A	Collect, Prepare and Ship Samples Sample Management	69 114	01MAY00 01MAY00	03AUG00 05OCT00	382	
	Data Validation (EPA) Data Validation (Non-RAS)	99	22MAY00 22MAY00	05OCT00 05OCT00	351 382	
0180508A	Data Validation Report (Non-RAS) Data Reduction, Tabulation and Evaluation	0	03JUL00	05OCT00 17NOV00	382 351	2
THE RESERVE OF THE PARTY OF	NVESTIGATION	100	03JUL00	17110700	351	
0180303B	Field Investigation	66	04AUG00	03NOV00 10NOV00	356	
0180401B	Demobilization Innovative Methods/Field Screening	66	06NOV00 04AUG00	03NOV00	361	
0180403B 0180405B	CLP/DESA/EPA-ERT Analytical Services Non-RAS	81 90	04AUG00 04AUG00	24NOV00 07DEC00	318	
	Collect, Prepare and Ship Samples Sample Management	66 109	04AUG00 04AUG00	03NOV00 05JAN01	361 318	
0180505B	Data Validation (EPA)	94	25AUG00	05JAN01	0	
	Data Validation (Non-RAS) Data Validation Report (Non-RAS)	94	25AUG00	05JAN01 05JAN01	318 318	
	Data Usability Evaluation Data Reduction, Tabulation and Evaluation	10 94	08JAN01 06OCT00	19JAN01 16FEB01	308 253	
0180607B	Data Evaluation Report	15	19FEB01 12MAR01	09MAR01 06APR01	253 253	3
	EPA Review Data Evaluation Report Technical/Phase II Scoping Meeting	0	12MAH01	06APR01	253	
	I INVESTIGATION (OPTIONAL)	E STEEL				
	ASSESSMENT OF RISK Draft HHRA	33	09JAN01	22FEB01	254	4
Γ0180703	EPA Review HHRA Finalize HHRA	20	23FEB01 23MAR01	22MAR01	254 254	4
Γ0180711	Draft ERA	10 33	09JAN01	05APR01 22FEB01	254	4
	EPA Review ERA Finalize ERA	20 10	23FEB01 23MAR01	22MAR01 05APR01	254 254	
A TANKS IN A SECTION AND ADDRESS OF THE PARTY OF THE PART	REATABILITY STUDY/PILOT TEST					
	Literature Search EPA Review of Literature Search	20 19	02OCT00* 30OCT00	27OCT00 23NOV00	0	
	Draft Treatability Study Work Plan EPA Review of Draft TWSP	22 10	24NOV00 27DEC00	26DEC00 10JAN01	0	
0180809	Finalize TSWP	10	11JAN01	24JAN01	0	
	Treatability Studies Treatability Study Report	64 21	24JAN01 24APR01	23APR01 22MAY01	0	
	REMEDIAL INVESTIGATION REPOR	_				
	Preparation of Draft RI Report QC Review Draft RI Report	54 10	09JAN01 26MAR01	23MAR01 06APR01	0	
	EPA Review of Draft RI Report Finalize RI Report	21 21	09APR01 08MAY01	07MAY01 05JUN01	0	
	Submit to EPA Final RI Report	0	COMPATOT	05JUN01	0	
	REMEDIAL ALTERNATIVES SCREET Draft Technical Memorandum	NING 43	06JUN01	03AUG01	107	
0181003	EPA Review of Technical Memo	10	06AUG01	17AUG01	107	7
0181005	Finalize Technical Memorandum REMEDIAL ALTERNATIVES EVALUA	ATION	20AUG01	31AUG01	107	
Г0181101	Draft Technical Memorandum	21	03SEP01	01OCT01	107	
0181103 0181105	EPA Review of Technical Memo Finalize Technical Memorandum	10	02OCT01 16OCT01	15OCT01 29OCT01	107 107	
TASK 12 F	S REPORT AND RI/FS REPORT	EN PA				
0181200	Preparation of Draft FS Report QC Review Draft FS Report	63 10	23MAY01 20AUG01	17AUG01 31AUG01	0	
0181203	EPA Review Draft FS Report	22	03SEP01	02OCT01	0	0
	Finalize Feasibility Study Report Submit to EPA Final FS Report	22	03OCT01	01NOV01 01NOV01	104	
	POST RI/FS SUPPORT	0.1	20NOVE	DADEGO:		
0181303	Draft FS Addendum EPA Review FS Addendum	10	30NOV01 02JAN02	31DEC01 15JAN02	0	
	Finalize FS Addendum	10	16JAN02	29JAN02	0	0
0181401	Technical Support at Negotiation Meetings	0		30JAN02*	42	
0181403	Review/Comment on PRP Documents	0		30JAN02*	42	
	ADMINISTRATIVE RECORD Provide Updated Deliverables	731	30MAR99*	30JAN02	42	2
TASK 16 V	WORK ASSIGNMENT CLOSE OUT					
	Work Assignment Close-Out Notification Work Assignment Completion Report	21 22	30JAN02 28FEB02	27FEB02 29MAR02	0	
	goniplotton risport			1-2.30 1102		
		JUL98 N01	1Ω	-	AC II	II PROGRAM Sheet 1 of 1 Early Bar
tart Date	07.	JOE 98 1140	10	-	1941	II F HOUHAW
nish Date	29N	1AR02		100		BILIER ELECTRONICS Progress Ba
	29N	MAR02 JUL98		RNELL	-DUB	BILIER ELECTRONICS Progress Ba
nish Date ata Date	29M 07.	MAR02 JUL98		RNELL	-DUB	BILIER ELECTRONICS Progress Ba

4.3 COST ESTIMATE

The estimated cost for completing the scope of work specified in this Work Plan and the total level of effort (LOE) estimate is found in the Optional Form 60 (OF-60), which will be submitted under a separate cover.

5.0 REFERENCES

Adamus, P.R., Clairain, E.J., Jr., Smith R.D., and Young, R.E. 1987. Wetland Evaluation Technique (WET) Volume II: Methodology. Operational Draft Technical Report Y-87-1. US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Federal Interagency Committee for Wetland Delineation. 1989. Federal Manual for Identifying and Delineating Jurisdictional Wetlands. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Washington, DC. Cooperative technical publication.

Groundwater Technology, Inc. 1994. Results of Public Records Review. Hamilton Industrial Park Area, South Plainfield, New Jersey.

Middlesex Water Company, 1999. Cornell-Dubilier Site Geologic Data.

NJDEP 1991. Pitt Street Private Wells, South Plainfield Borough, Middlesex County, Interim Groundwater Impact Area.

USEPA 1999. Statement of Work.

USEPA 1999a. Sampling History.

USEPA 1998. Draft Risk Assessment for Cornell-Dubilier Electronics Superfund Site, South Plainfield, New Jersey. USEPA. Edison, NJ.

USEPA 1996. Final Hazard Ranking System Documentation. Cornell-Dubilier Electronics, Inc. Site.

USEPA 1996a. Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites. Final Guidance. EPA 540/R-96/023. October 1996.

USEPA 1993a. Evaluation of the Likelihood of DNAPL Presence at NPL Sites, National Results. OSWER Publication 9355.4-13. September 1993.

USEPA. DNAPL Site Characterization. EPA/542-F94/049.

USEPA, 1993b. Presumptive Remedies: site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils. OSWER Directive 9355.0-48FS. EPA/540-F-93-048. September 1993.

USEPA 1994. Methods for Measuring the Toxicity and Bioaccumulation of Sediment Associated Contaminants with Freshwater Invertebrates. USEPA. Office of Research and Development, Washington, DC. EPA/600/R-94/024.

USEPA 1993. Stream Bioassessment, Bound Brook, New Jersey. USEPA Region II, Ambient Monitoring Section. Environmental Services Division (ESD). New York, New York.

USEPA, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. USEPA Office of Emergency and Remedial Response.

USEPA, Washington, DC. Office of Emergency and Remedial Response. 1989. Considerations in Ground Water Remediation at Superfund Sites. OSWER Directive 9355.4-03.

USEPA, Washington, DC. Office of Emergency and Remedial Response. 1992. Considerations in Ground Water Remediation at Superfund sites and RCRA Facilities - Update. OSWER-9283.1-06.

USGS, 1968. Special Report No. 27, Groundwater Supplies of Middlesex County, New Jersey.

USGS, 1943. Special Report No. 8, Groundwater Supplies of Middlesex County, New Jersey.

Weston, 1998. Tier I Sampling and Analyses Summary Report.

Weston, 1998a. Tier II Residential Sampling and Analyses Summary Report.

Weston, 1998b. Tier III Residential/Neighborhood Sampling and Analyses Report.

Weston, 1998c. Soil and Sediment Sampling and Analysis Summary Report.

Weston, 1998d. Final Vacuum Dust Report for USEPA/ERT.

Weston, 1998e. Final Vacuum Dust Report for USEPA/ERT.

Weston, 1998f. Final Vacuum, Wipe and Soil Sampling Report for USEPA/ERT.

ATTACHMENT 1

POTENTIAL EQUIPMENT TO BE LEASED/RENTED FOR FIELD PROGRAM/COMMUNITY RELATIONS

Equipment	Estimated Quantity
Rediflo Grundfos Water Pump	2
Rediflo Controller	2
Horiba U-10 Meter w/Flow through Cell and U-10 Auto	•
Calibration Kit and Solutions	2
Oil/Water Interface Probe/Water Level Indicator (100 ft)	2
Micro-FID Flame Ionization Detector	2
Photovac Microtip w/10.6 eV Lamp Photoionization	_
Detector (PID)	2
Combustible Gas Indicator (CGI) O ₂ Meter	2
Sensidyne Piston Pump (for detector tubes)	1
Sound Level Meter	1
Electrical Generator	1
Vehicles	2
Radios	6
Decontamination Chemical Cabinet	1
Floor Dust Sampling Apparatus	1
Magnetometer	i
Laptop Computer (Geophysical Survey)	1
Leica System 530 Rover and Base	1
Geometrics G-858G Gradiometer	1
Geometrics G-858 Base Mag	1
Geonics EM-31 MK2	1
Public Address System	1 -

USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
FIELD OPERATIONS PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

NOTICE

THE INFORMATION PROVIDED IN THIS DOCUMENT HAS BEEN FUNDED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) UNDER RAC II CONTRACT NO. 68-W-98-214 TO FOSTER WHEELER ENVIRONMENTAL CORPORATION (FOSTER WHEELER ENVIRONMENTAL). THIS DOCUMENT HAS BEEN FORMALLY RELEASED BY FOSTER WHEELER ENVIRONMENTAL TO THE USEPA. THIS DOCUMENT DOES NOT, HOWEVER, REPRESENT USEPA POSITION OR POLICY, AND HAS NOT BEEN FORMALLY RELEASED BY THE USEPA.

USEPA WORK ASSIGNMENT NUMBER:018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
FIELD OPERATIONS PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

Prepared by:

Daniel M. Miller, Ph.D.

Project Manager

Foster Wheeler Environmental

Reviewed by:

Ming Kuo, Ph.D., P.E.

RAC II Technical Quality Control Manager

Foster Wheeler Environmental

Approved by:

Der R. Snohaler

Dev Sachdev, Ph.D., P.E. RAC II Program Manager Foster Wheeler Environmental

EXECUTIVE SUMMARY

Foster Wheeler Environmental Corporation has prepared this Field Operations Plan (FOP) to support the Remedial Investigation/Feasiblity Study (RI/FS) for the Cornell-Dubilier Electronics Superfund Site. The sections of the FOP provide direction for the field operations, ensuring that the field investigation will be performed in a safe manner and at a level of quality appropriate for the project needs. Furthermore, the scope of work for this FOP is consistent with the Work Plan for the Cornell-Dubilier Electronics Superfund Site, dated March 2000.

The FOP includes four major parts, the Field Sampling Plan (FSP), the Site Management Plan (SMP), the Quality Assurance Project Plan (QAPP), and the Environmental Health and Safety Plan (EHS Plan). The FSP defines specific standard operating procedures to be followed during the field investigation activities. The SMP includes a description of the site operations, including the project organization and the field activity schedule. The QAPP provides the quality assurance objectives and requirements. Health and safety considerations, including a contingency plan for unanticipated emergencies, are described in the EHS Plan.

PART A: FIELD SAMPLING PLAN

PART B: SITE MANAGEMENT PLAN

PART C: QUALITY ASSURANCE PROJECT PLAN

PART D: ENVIRONMENTAL HEALTH AND SAFETY PLAN

R:\TECH\RAC\CORNELL\FOP\cover.WPD 300105

PART A: FIELD SAMPLING PLAN

USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
FIELD SAMPLING PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY
MARCH 2000

NOTICE

THE INFORMATION PROVIDED IN THIS DOCUMENT HAS BEEN FUNDED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) UNDER RAC II CONTRACT NO. 68-W-98-214 TO FOSTER WHEELER ENVIRONMENTAL CORPORATION (FOSTER WHEELER ENVIRONMENTAL). THIS DOCUMENT HAS BEEN FORMALLY RELEASED BY FOSTER WHEELER ENVIRONMENTAL CORPORATION TO THE USEPA. THIS DOCUMENT DOES NOT, HOWEVER, REPRESENT USEPA POSITION OR POLICY, AND HAS NOT BEEN FORMALLY RELEASED BY THE USEPA.

USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
FIELD SAMPLING PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

Prepared by:

∦nn Niles

Environmental Chemist

Foster Wheeler Environmental

Reviewed by:

Thomas Fowler, CPGS

Principal Hydrogeologist

Foster Wheeler Environmental

Approved by:

Der R. Sachder

Dev Sachdev, Ph.D., P.E.

RAC II Program Manager

Foster Wheeler Environmental

TABLE OF CONTENTS

Sectio	<u>n</u>			<u>Page</u>
1.0	INTR	<u>ODUCTION</u>		1-1
	1.1 1.2	SITE LOCATIONS		1-1 1-4
2.0	PROC	RAM OBJECTI	<u>VES</u>	2-1
	2.1 2.2 2.3 2.4	FIELD INVEST TECHNICAL O	TY OBJECTIVES TIGATION APPROACH GUIDELINES RESPONSIBILITIES	2-1 2-2 2-2 2-2
3.0	<u>FIELI</u>	<u>INVESTIGATI</u>	ON ACTIVITIES	3-1
	3.1	SAMPLE SUM	MARY	3-2
		3.1.2 <u>Sample</u> 3.1.3 <u>Sample</u>	Identification System Analytical Requirements Preservation, Packaging and Shipping Documentation	3-2 3-2 3-2 3-4
	3.2	QUALITY ASS	SURANCE/QUALITY CONTROL	3-4
	2.2	3.2.2 <u>QA/QC</u> 3.2.3 <u>Analytic</u>	Strument Calibration and Preventive Maintenance Sample Collection cal Data Handling, Validation and Reporting	3-4 3-4 3-5
	3.3	SAMPLING PR	KUGRAM	3-5
		3.3.2 <u>Site Sur</u> 3.3.3 <u>Geophy</u> 3.3.4 <u>Soil Gas</u>	sical Survey S Survey	3-5 3-6 3-8
		3.3.7 <u>Test Pit</u>	ting Interior Sampling [Floor Dust] Investigation Is and Habitat Delineation	3-9 3-10 3-12 3-13
		3.3.9 <u>Off-Site</u> 3.3.10 <u>On-Site</u> 3.3.11 <u>On-Site</u>	Residential/Commercial Property Soil Sampling Surface Soil Sampling Subsurface Soil Sampling	3-15 3-17 3-19
		3.3.13 <u>Hydropi</u> 3.3.14 <u>Monitor</u>	nple Field Screening unch® Sampling ing Well Installation and Development e System Sampling	3-21 3-22 3-23 3-27

i

TABLE OF CONTENTS (Cont'd)

Section		<u>Page</u>
3.3.16	Building Interior Sampling [Air]	3-28
3.3.17	Ecological Resources Reconnaissance	3-31
	Sediment Sampling	3-31
	Surface Water Sampling	3-34
	Biota Sampling	3-35
	Water Level Measurement	3-38
	Groundwater Sampling	3-39
	Aquifer Testing	3-42
3.3.24	<u>Decontamination</u>	3-44
4.0 <u>REFERENCE</u>	<u>S</u>	4-1
ATTACHMENT A	ASTM STANDARD METHODS AND PRACTICES	
D422-63	Standard Test Method for Particle-Size Analysis of Soils	
D1586-84	Standard Test Method for Penetration Test and Split-Barrel Sampling	of Soils
D4050-96	Standard Test Method (Field Procedure) for Withdrawal and Injecti	•
D4105-96	Tests for Determining Hydraulic Properties of Aquifer Systems Standard Test Method (Analytical Procedure) for Determining Transmand Storage Coefficient of Nonleaky Confined Aquifers by the Market Nonle	•
D4106-96	Theis Nonequilibrium Method Standard Test Method (Analytical Procedure) for Determining Transn and Storage Coefficient of Nonleaky Confined Aquifers by th Nonequilibrium Method	
D5438-94	Standard Practice for Collection of Floor Dust for Chemical Analyst	sis
ATTACHMENT B SCI-003 SCI-004	FWENC TECHNICAL GUIDELINES Equipment Calibration and Maintenance Requirements Sample Preservation, Chain of Custody, Packaging and Shipping	
ATTACHMENT C Appendix 7-1	NJDEP FIELD SAMPLING PROCEDURES NJDEP Monitoring Well Specifications for Bedrock, Unconsolidated Confined Aquifers	
AGWST 6.00	Ground Water Sampling with the Use of a HydroPunch® Direct Pus	h Sampler
ATTACHMENT D	USEPA REGION II GROUNDWATER SAMPLING PROCEDUR Low Stress Purging and Sampling	RE

TABLE OF CONTENTS (Cont'd)

ATTACHMENT E USEPA ERT STANDARD OPERATING PROCEDURES

SOP	#1704 Summa Canister Sampling #2006 Sampling Equipment Decontamination #2013 Surface Water Sampling					
	#2015 Asbestos Sampling					
SOP	#2016 Sediment Sampling					
SOP	#2042 Soil Gas Sampling					
SOP	#2109 Photovac GC Analysis for Soil, Water, and Air/Soil Gas					
SOP	#2119 Air Sampling for Metals					
SOP	#2121 High Volume Polyurethane Foam Sampling					
	LIST OF TABLES					
Table No.	<u>Title</u>	Page				
2-1	Field Investigation Activity Sequence	2-3				
3-1	Summary of Analytical Program - Reconnaissance Phase and Phase I Investigation	3-3				
3-2	Summary of Residential/Commercial Property Soil Sampling Locations	3-3 3-16				
3-3	Summary of Casing Requirements					
	LIST OF FIGURES					
Figure No.	<u>Title</u>	Page				
1-1	Site Location Map	1-2				
1-2	Site Map	1-3				
2-1	Potential Geophysical Survey Area and Soil Gas Survey					
2.2	Locations Petertial Programs of Phase and Phase I Investigation	2-6				
2-2	Potential Reconnaissance Phase and Phase I Investigation Sampling Locations	2-7				

1.0 INTRODUCTION

Presented herein is the Field Sampling Plan (FSP) for the Remedial Investigation/Feasibility Study (RI/FS) to be implemented for the Cornell-Dubilier Electronics Superfund (Cornell-Dubilier) Site by Foster Wheeler Environmental Corporation (Foster Wheeler Environmental). The purpose of this FSP is to present a sampling program sufficient to develop an adequate database for the selection of a remedy to eliminate, reduce, or control risks to human health and the environment, as per the Work Plan for the Site (FWENC, 2000a).

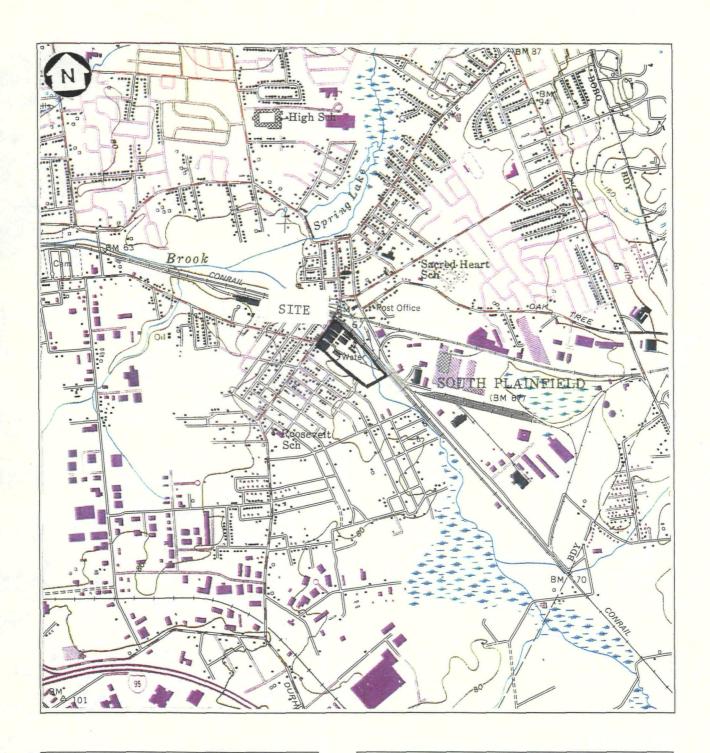
The FSP presents the procedures to be followed during field investigation activities. Specifically, the FSP addresses:

- Data Quality Objectives
- Applicable Technical Guidelines
- Responsibilities of Site Personnel
- Sample Analytical Program
- Sample Packaging and Shipment
- Documentation
- Field Sampling Program Operations Procedures

1.1 SITE LOCATION

The Cornell-Dubilier Site is a 25-acre site located at 333 Hamilton Boulevard, in South Plainfield, Middlesex County, New Jersey. The Hamilton Industrial Park, which consists of approximately 15 small industries, currently occupies the Site property. The Site is bordered by Bound Brook and railway tracks to the northeast, Hamilton Boulevard and residential and commercial properties to the northwest, the South Plainfield Department of Public Works property to the southeast, and Spicer Avenue and residential properties to the southwest. A Site Area Location Map is presented in Figure 1-1 and a Site Plan is presented in Figure 1-2.

Currently, the Hamilton Industrial Park is located in the western portion of the Site, which is largely paved or occupied by buildings. All areas used as driveways, parking areas and walkways were paved by the property owner pursuant to an administrative order issued by USEPA in March 1997. Site control measures including the installation of a six-foot chain-link fence, posting of warning signs, and implementing engineering controls to limit the migration of contaminants through surface water run-off were also instituted pursuant to this order. The western Site area is gently sloping, with elevations ranging from approximately 71 to 81 feet above mean sea level (msl). The middle portion of the Site is primarily an open field, with some wooded areas to the south and a paved area in the fenced area in the center. This area is relatively level, with elevations ranging from approximately 72 to 75 feet above msl. The Site drops steeply to the east, and the eastern portion of the Site consists primarily of a wetland area bordering Bound Brook. Elevations in this area range from approximately 72 feet above msl at the top of the bank to approximately 60 feet above msl along Bound Brook.



SOURCE: US Geological Survey 7.5-minute topographic map for Plainfield, New Jersey.

SCALE: 1: 24 000

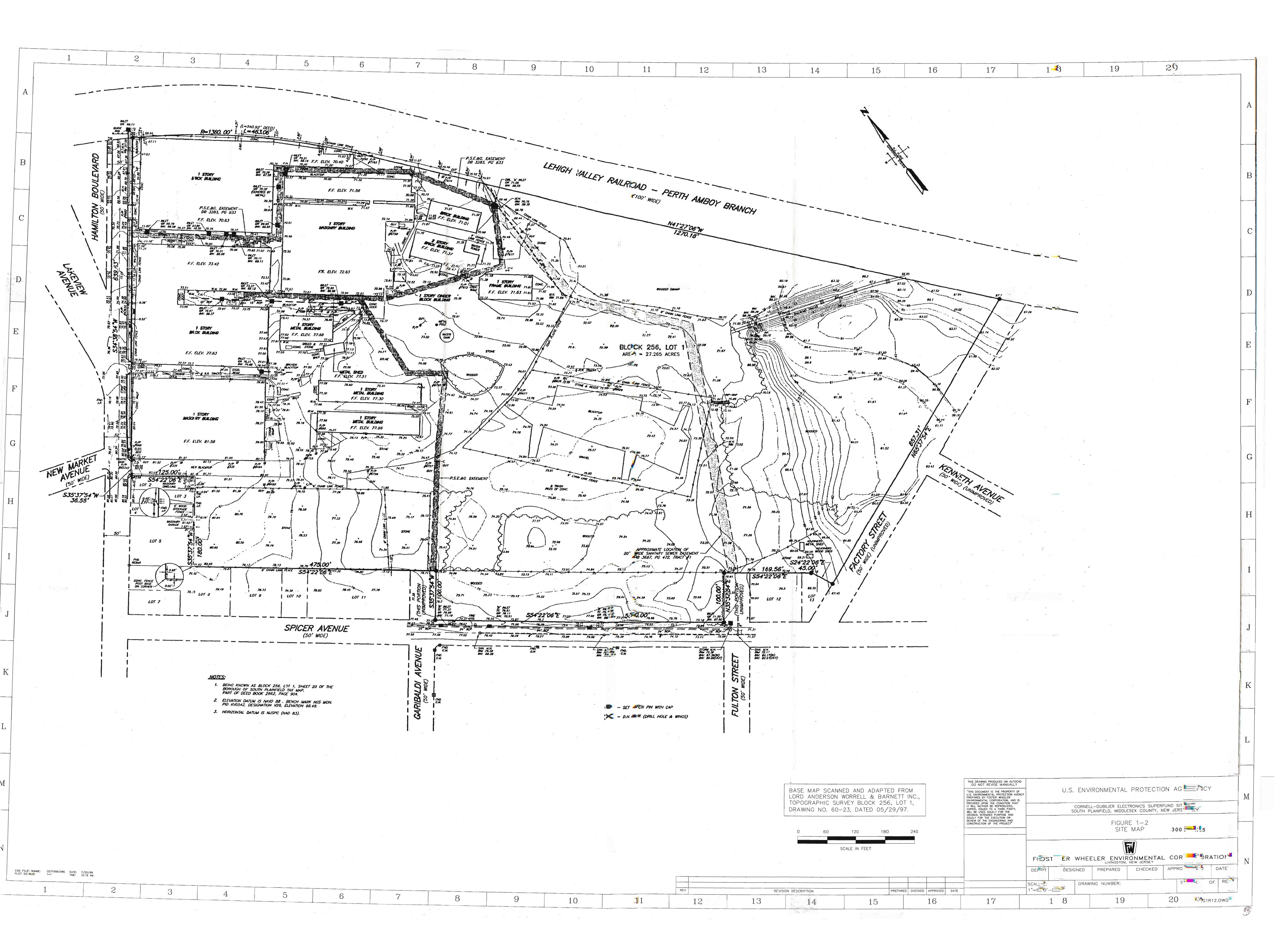
US ENVIRONMENTAL PROTECTION AGENCY

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, MIDDLESEX COUNTY, NEW JERSEY

FIGURE 1-1 SITE LOCATION MAP

FOSTER WHEELER ENVIRONMENTAL CORPORATION



THIS PAGE WAS INTENTIONALLY LEFT BLANK FOR PAGINATION PURPOSES

1.2 SITE HISTORY

The following presents an overview of the Cornell-Dubilier Site history. Additional, more detailed information is presented in Section 1.2 of the Work Plan.

From 1936 to 1962, Cornell-Dubilier Electronics, Inc. manufactured electronic components, including capacitors, on the Site property. Allegedly, during its operations, the company disposed of transformer oil and other materials contaminated with polychlorinated biphenyls (PCBs) directly onto site soils. Residual wastes from the on-site processes may also have been landfilled on the site property, including trichloroethene (TCE) which was used during operations as a degreasing agent.

Personnel from the New Jersey Department of Environmental Protection (NJDEP) visited the Site on March 12, 1985, and noted that an area in the rear of the facility contained black soil. In addition, four large black tanks were present on the edge of a large filled-in area, situated in the rear of the Site. These tanks were at the top of the embankment leading down to Bound Brook.

On September 11, 1986, NJDEP conducted a site inspection and collected soil, surface water, and sediment samples at the Site. Metals, volatile organic compounds (VOCs) and PCBs were detected in the soil and sediment samples.

The United States Environmental Protection Agency (USEPA) collected surface soil, sediment, and surface water samples from the Site on June 8, 1994. PCBs and various metals were detected at elevated concentrations in the soils. A sediment sample from the stream near the rear of the property contained Aroclor-1254, 1,2-dichloroethene, trichloroethene, and lead. Aroclor-1254, 1,2-dichloroethene, trichloroethene, and lead were also detected in surface water samples, along with Arolcor-1248 and other heavy metals.

A screening-level ecological risk assessment was performed by USEPA in June 1996. The assessment indicated that contamination of stream sediments adjacent to the Site, and apparently associated with the Site, were present at levels which have been linked to adverse impacts in benthic organisms.

On June 27 and 29, 1996, USEPA collected additional surface and subsurface soil samples from a roadway, a vacant field, and a foot/bike path on the Site. Surface soil samples contained Aroclor-1254 up to 51,000 mg/kg, and the sample with the maximum concentration was collected near the northeast corner of the fenced area, where electrical and transformer parts were exposed in a swale. Aroclor-1254 was also detected on the surface of the roadway (maximum value: 340 mg/kg) and along the foot/bike path (maximum value: 3,000 mg/kg). In addition, the more elevated concentrations of lead and cadmium were noted in the northeast corner of the fenced area and near the foot/bike path.

Test pits were excavated in the vacant field during July 1996. The test pits revealed stained soils, drum carcasses, electrical parts, mica-like chips, wood, and other debris. Aroclor-1254 and lead were detected in test pit soil samples.

On March 25, 1997, a unilateral administrative order was issued to the owner of the industrial park, which required the paving of facility driveways and parking areas, the installation of security and silt fencing to reduce migration of contaminants, and the posting of warning signs.

In March and June 1997, USEPA conducted building interior sampling (wipe, chip and vacuum) at the Site. Aroclor-1248, Aroclor-1254 and/or weathered Aroclor-1260 were detected in the samples, along with lead and cadmium.

USEPA collected additional samples in June and August 1997, including soil, sediment, water and biota samples. PCBs (up to 13 mg/kg) and four metals were detected in the sediment and floodplain soils. Fish tissue samples contained two PCBs and seven pesticides. NJDEP issued an interim fish consumption advisory for Bound Brook and New Market Pond on August 9, 1997.

In October and November 1997, USEPA collected soil and dust samples, respectively, at nearby residential properties (referred to as Tier I). Additional soil sampling activities were conducted in April 1998 (referred to as Tier II) and May 1998 (referred to as Tier III). The interiors of seven Tier I residences, where PCBs were present at levels of potential health concern, were cleaned in April 1998, and sampling of residential interiors were performed at 36 residences from April 21 through 28, 1998. On November 14, 1998, surface soil samples were again collected from one of the properties along Spicer Avenue (referred to as Addendum to Tier I). Elevated levels of PCBs were noted in soils and dust at several residences located near the Site.

The Cornell-Dubilier Electronics Superfund Site was listed on the federal National Priorities List (NPL) of hazardous waste sites on July 28, 1998.

In August 1998, Cornell-Dubilier Electronics and D.S.C. of Newark, Inc. (the current property owner) entered into an Administrative Consent Order for a removal action which includes removal and disposal of contaminated soil from five residential properties and the delineation of contamination at a sixth. In March 1999, USEPA ordered Cornell-Dubilier Electronics and D.S.C. of Newark, Inc. to conduct a removal action at seven additional residential properties.

In November 1998 and June 1999, USEPA collected additional samples from various locations along Bound Brook. The samples were analyzed for total PCBs, and concentrations ranged from non-detect to 25 ppm.

The Environmental Measurements and Site Assessment Section (EMSA) of NJDEP conducted sediment sampling in Spring Lake and along Cedar Brook from Plainfield High School to the lake in April of 1999. Sediment samples were also collected along a feeder stream from Maple Avenue to Cedar Brook. No PCBs were detected in any of the samples collected. However, alpha- and gamma-chlordane, DDT and DDD were present at concentrations as high as 0.69 ppm.

Between June and July 1999, Environ Corporation conducted a preliminary evaluation of groundwater conditions at the Site. Bedrock was encountered at depths of 6 to 13 feet below ground surface. Trichloroethene and 1,2-dichloroethene were detected at concentrations as high as 29,000 ug/L and 14,000 ug/L, respectively. Aroclor-1254 and Aroclor-1242 were also present, at concentrations ranging up to 14 ug/L and 130 ug/L, respectively.

2.0 PROGRAM OBJECTIVES

2.1 DATA QUALITY OBJECTIVES

The Data Quality Objectives (DQOs) for the Cornell-Dubilier Site were developed based upon USEPA 600/R-96/055, "Guidance for the Data Quality Objectives Process," EPA QA/G-4 (USEPA, 1994) and USEPA Order 5360, "EPA Quality Manual for Environmental Programs" (USEPA, 1998). For the Cornell-Dubilier Site, screening data generated by rapid, less precise methods of analysis will achieve a data use for site characterization and monitoring. Definitive laboratory analytical data generated during the field investigation will achieve a data use to support risk assessment, including data validation of sampling results.

Specifically, these data will be used to:

- Confirm and further define the nature and extent of surface and subsurface soil contamination, through the comparison of constituent results to applicable criteria and the development of isoconcentration maps;
- Confirm and further define the nature and extent of sediment and surface water contamination, through the comparison of constituent results to applicable criteria and the development of isoconcentration maps;
- Confirm and further define the nature and extent of biota contamination, through the comparison of constituent results to applicable criteria;
- Confirm and further define the nature and extent of building interior contamination, through the comparison of constituent results to applicable criteria;
- Define the nature and extent of overburden and bedrock groundwater contamination, through the comparison of constituent results to applicable criteria and the development of isoconcentration maps;
- Obtain sufficient data (i.e., greater than or equal to 90 percent complete; see Section 3.3 of the Quality Assurance Project Plan [QAPP], Part C) for the performance of Human Health and Ecological risk assessments; and
- Obtain sufficient data (i.e., greater than or equal to 90 percent complete; see Section 3.3 of the QAPP) for the screening and evaluation of appropriate remedial alternatives during the Feasibility Study.

The data are intended for use in the Human Health and Ecological Risk Assessments and the Feasibility Study. Therefore, all of the analytical results will be subjected to data validation, based on an evaluation of method-specific and regional-specific quality assurance/quality control (QA/QC) information. Further information on QA/QC project objectives, DQOs and applicable criteria is provided in the QAPP (Part C of the Field Operations Plan).

2.2 FIELD INVESTIGATION APPROACH

Due considerably to the limited quantity of prior environmental sampling at the Site, Foster Wheeler Environmental will utilize a sequential approach to the field investigation program, whereby the placement of environmental sampling locations will be dependent on the results of prior reconnaissance and/or sampling tasks. All results obtained during each task will be used to optimize placement of subsequent locations. This approach will require a high degree of coordination between Foster Wheeler Environmental and USEPA personnel, both in the field and in the office.

To ensure that a sequential approach to the field investigation program is adhered to and that the DQOs established for the Cornell-Dubilier Site are achieved, field activities will proceed in accordance with the Field Investigation Activity Sequence presented in Table 2-1. Critical points where USEPA input is required have been identified in the table. Figure 2-1 provides the approximate areas for the Reconnaissance Phase geophysical and soil gas surveys and the estimated sample locations for the Phase I Investigation. Actual Phase I Investigation locations may be modified based on the Reconnaissance Phase surveys. General site operations and field methodologies to be employed are described in the following sections.

2.3 TECHNICAL GUIDELINES

Technical guidelines were utilized in the preparation of the requirements and sample collection procedures specified in this FSP. These guidelines included American Society for Testing and Materials (ASTM) standard methods and practices, Foster Wheeler Environmental technical guidelines, NJDEP Field Sampling Procedures, USEPA Region II groundwater sampling procedures, and USEPA Environmental Response Team (ERT) Standard Operating Procedures (see excerpts provided in Attachments A, B, C, D and E, respectively). However, the guidelines are not intended to encompass the full range of conditions found in the field. Therefore, these guidelines have been modified to meet the field conditions, as necessary, and do not take precedence over the requirements/procedures presented in Section 3.0 of this FSP.

In the second of the second of

TABLE 2-1 (Sheet 1 of 3) FIELD INVESTIGATION ACTIVITY SEQUENCE

Reconnaissance Phase

- 1. Mobilize personnel, equipment, etc. to Cornell-Dubilier Site. Confirm that all necessary property access agreements have been secured by USEPA.
- 2. Survey residential property locations and update survey of Site proper.
- 3. Prepare residential surface soil sampling grids, and submit to USEPA for approval.
- 4. Perform geophysical survey on central and southwestern portions of Site (see Figure 2-1).
- 5. Locate sumps/pits/drains in Site buildings. Also locate drains/catch basins/outfalls on Site. Attempt to locate and determine condition of Site production wells. Open all manholes around the Site to determine if standing water is present.
- 6. Perform dye testing of sumps/pits/drains as necessary to determine discharge locations.
- 7. Collect floor dust samples from the on-site buildings.
- 8. Perform soil gas survey (see Figure 2-1).
- 9. Based on geophysical survey, soil gas survey and dye testing, excavate 10 test pits. Soil and/or groundwater samples will be collected as necessary and appropriate (e.g., stained soil, groundwater with sheen, odors, elevated PID/FID readings, etc.), up to a maximum of 10 (see Figure 2-2).
- 10. Perform wetlands and habitat delineation.
- 11. Select locations for surface soil sampling along railroad right-of-way.
- 12. Collect residential surface soil samples, following approved grid design.
- 13. Evaluate results of Reconnaissance Phase. Determine necessity to relocate approximate Phase I Investigation sampling locations (see Figure 2-2), and submit rationale to USEPA for approval if necessary. [This task may extend beyond demobilization, to be completed in the office.]
- 14. Demobilize personnel, equipment, etc. from Site, as appropriate.

Phase I Investigation

- 1. Mobilize personnel, equipment, etc. to Site.
- 2. Collect surface soil samples (0 to 6 inches, with 6 to 12 inches for VOCs) from each monitoring well location (see Figure 2-2).
- 3. Install 11 open hole monitoring wells (MW01 through MW11) in bedrock, to 10 feet below depth where groundwater was encountered (see Figure 2-2). Obtain soil samples from each well during drilling operations, and send 4 samples at the following depth intervals for laboratory analysis: between 0 feet and the top of weathered bedrock (depth dependent on field screening); at the top of weathered bedrock; between the top of weathered bedrock and competent bedrock (depth dependent on field screening); and at the top of competent bedrock. Also collect Hydropunch® or equivalent water samples if groundwater encountered in overburden and/or weathered bedrock for laboratory analysis.

TABLE 2-1 (Sheet 2 of 3) FIELD INVESTIGATION ACTIVITY SEQUENCE

Phase I Investigation (cont'd)

- 4. Install stream gauge in Bound Brook.
- 5. Obtain soil samples at depths of 0 to 6 inches (6 to 12 inches for VOCs) and 12 to 24 inches (18 to 24 inches for VOCs) below concrete from borings drilled in and around buildings, targeting former or active pits/drains/catch basins/etc.
- 6. Collect surface soil samples (0 to 6 inches, with 6 to 12 inches for VOCs) from the northeastern and eastern portions of the Site, and from along railroad right-of-way (see Figure 2-2).
- 7. Collect standing water and/or sediment samples from on-site manholes, catch basins, etc.
 - 8. Develop monitoring wells.
 - 9. Survey Phase I Investigation sampling locations and stream gauge elevation.
 - 10. Conduct first round of water level measurements (groundwater and surface water) and groundwater sampling on newly installed monitoring wells.
 - 11. Demobilize personnel, equipment, etc. from Site, as appropriate.

The following tasks are not specifically categorized as field tasks, and will most likely be performed following demobilization of the Phase I field effort (see Section 3.6 of the Work Plan for a more detailed description of the data evaluation task). The tasks are presented here to indicate their proper sequence in the RI investigation.

- Evaluate results of Reconnaissance Phase and Phase I Investigation.
- Determine additional sampling locations, including location(s) of upgradient monitoring well(s), and analytical parameters. Prepare an Addendum to the Work Plan, FSP, SMP, QAPP and EHS Plan, as necessary and appropriate, for these field tasks.
- Prepare Pumping Test Plan.
- Submit plans to USEPA for approval.

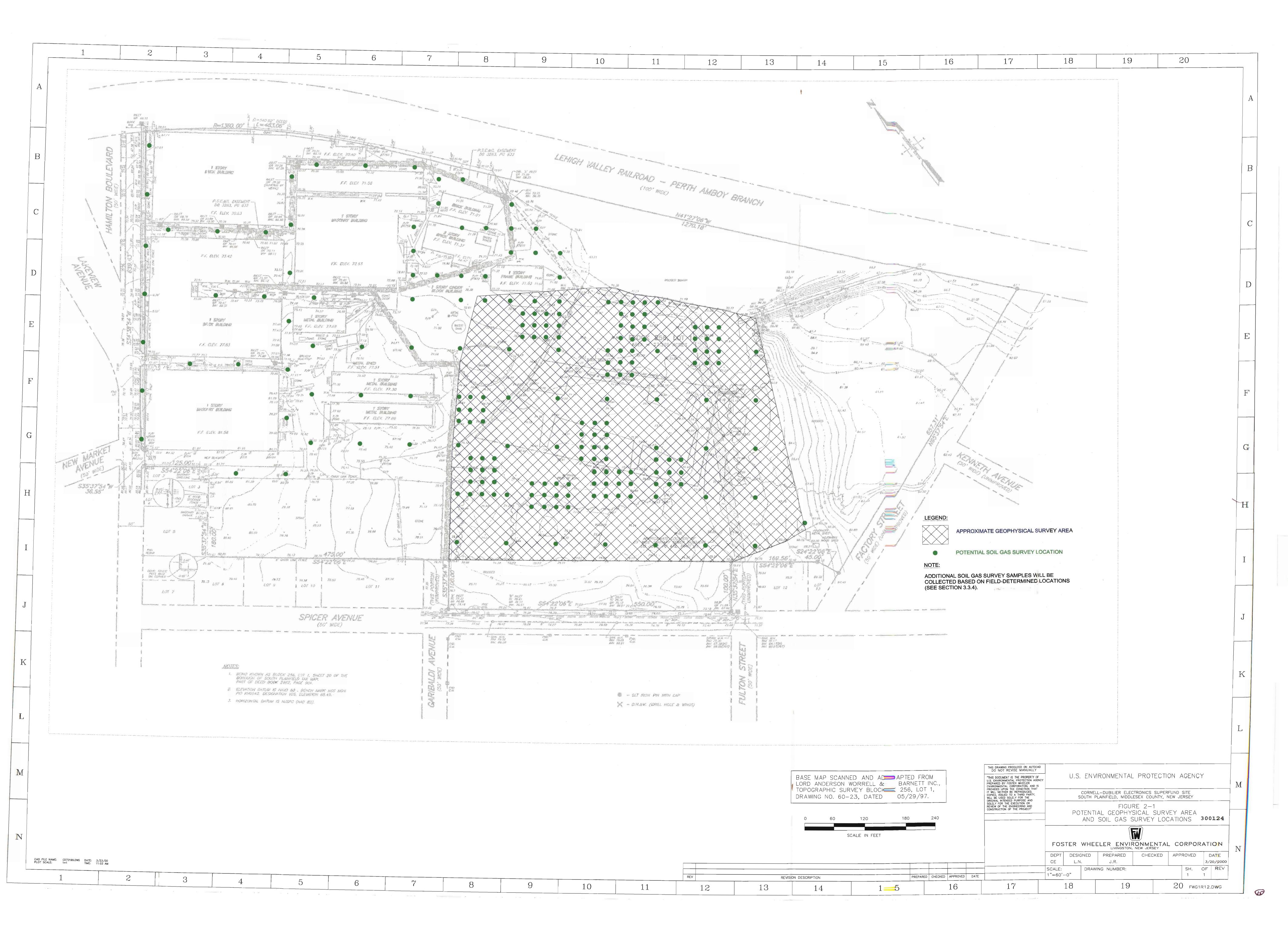
Phase II Investigation

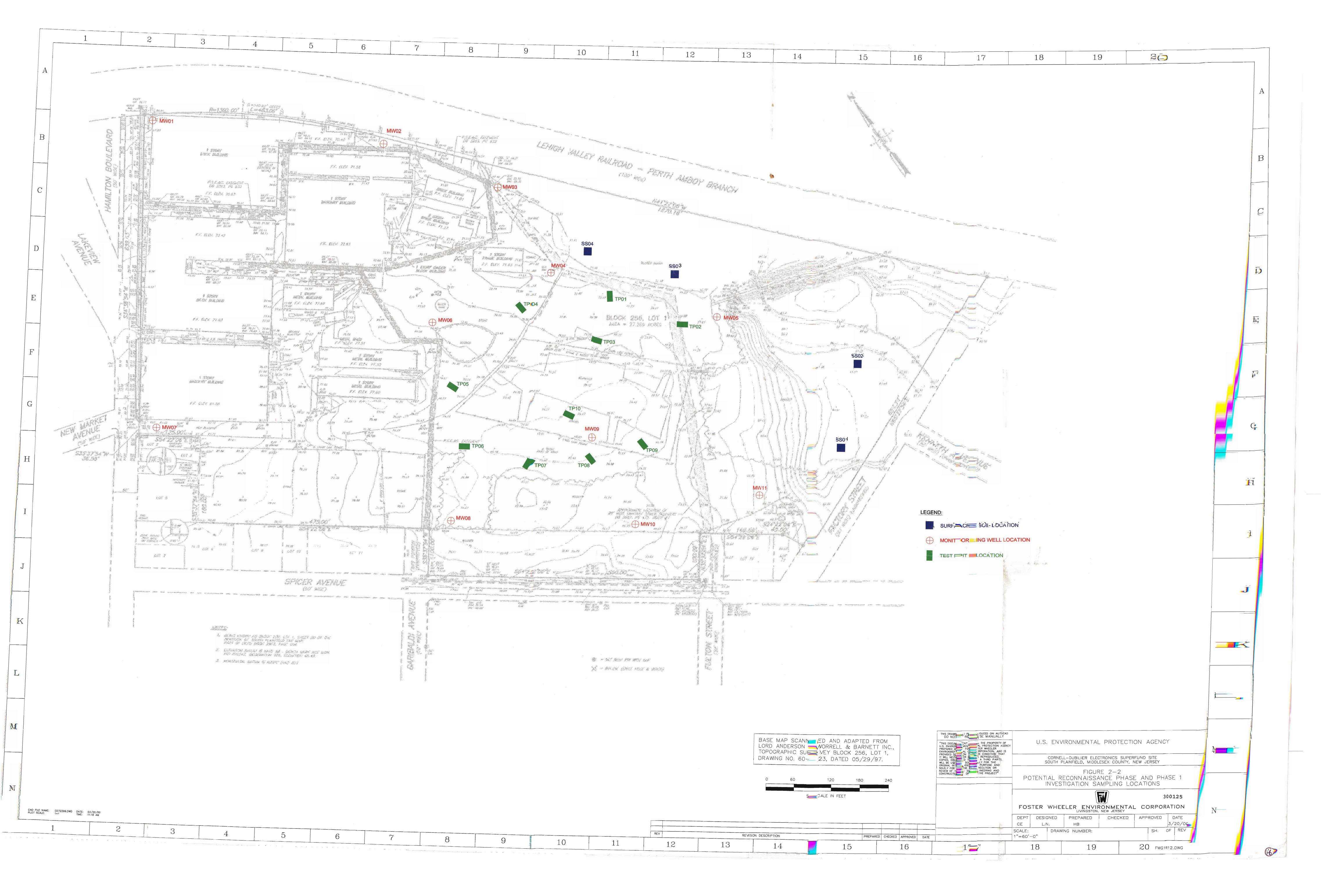
- 1. Mobilize personnel, equipment, etc. to Site.
- 2. Collect surface soil samples (0 to 6 inches, with 6 to 12 inches for VOCs) from each additional monitoring well location.
- 3. Install additional monitoring wells to selected depths.
- 4. Install piezometers and pumping well required for aquifer pumping test, as outlined in the Pumping Test Plan.
- 5. Obtain additional soil samples from borings in and around buildings, as applicable.

TABLE 2-1 (Sheet 3 of 3) FIELD INVESTIGATION ACTIVITY SEQUENCE

Phase II Investigation (cont'd)

- 6. Collect additional surface soil samples (0 to 6 inches, with 6 to 12 inches for VOCs), as applicable.
- 7. Collect sediment, surface water and/or biota samples, as applicable.
- 8. Develop newly installed monitoring wells and piezometers.
- 9. Survey new Phase II Investigation sampling locations.
- 10. Conduct second round of water level measurements (groundwater and surface water) and groundwater sampling on all monitoring wells.
- 11. Perform aquifer pumping test on selected well(s) as outlined in Pumping Test Plan.
- 12. Conduct third round of water level measurements (groundwater and surface water) and groundwater sampling on all monitoring wells, if required.
- 13. Demobilize personnel, equipment, etc. from Site.





THIS PAGE WAS INTENTIONALLY LEFT BLANK FOR PAGINATION PURPOSES

2.4 PERSONNEL RESPONSIBILITIES

The project team will include the following personnel:

- <u>Project Manager (PM)</u> has final responsibility for the development of the FSP and management of the project team.
- <u>Field Operations Leader (FOL)</u> is responsible for the management and supervision of the entire sampling program, provides consultation and decision-making on issues relating to sampling activities, and has authority to stop work if site conditions exceed allowable safety limits.
- <u>Site Chemist</u> is responsible for assuring that proper collection, packaging, preservation and shipping of samples is performed.
- <u>Site Geologist</u> is responsible for the geological and hydrogeological investigation.
- <u>Site Ecologist</u> is responsible for the ecological sampling investigation.
- <u>Site Environmental and Safety Supervisor (ESS)</u> is responsible for the safety of all Site personnel as detailed in the EHS Plan. The ESS also has authority to stop work if Site conditions exceed allowable safety limits.
- <u>Field Technician</u> is responsible for assisting in health and safety monitoring and field operations.
- <u>Drilling Subcontractor</u> is responsible for drilling permits, licenses, clearances, and supplying all services (including labor), equipment, and material required to perform the drilling, well installation and aquifer testing, in addition to all maintenance and quality control of such equipment. The drilling subcontractor will be responsible for following decontamination procedures specified in the FSP and in the bid package. Upon completion of the work, the drilling subcontractor will be responsible for demobilizing all equipment, cleaning any materials deposited on site during drilling operations, and properly backfilling any borings.
- <u>Surveying Subcontractor</u> is responsible for supplying all services (including labor), equipment, and material required to perform surveys of the Site, nearby residences and sampling locations.
- <u>Soil Gas Survey Subcontractor</u> is responsible for supplying all services (including labor), equipment, and material required to perform a soil gas survey, utilizing the active method, at the Site.
- <u>Waste Disposal Subcontractor</u> is responsible for the off-site transportation and disposal of investigation derived waste (IDW) residuals (such as PPE, drill cuttings, and purge and development water).

- <u>Non-Routine Analytical Services (Non-RAS) Analytical Services Subcontractor</u> is responsible for the delivery of Non-RAS sample bottles (pre-preserved as necessary) to the Site and subsequent pick-up and analysis of collected Non-RAS samples.
- <u>Mobilization Subcontractor</u> is responsible for supplying all services (including labor), equipment, and material required to establish the support trailers and services.
- <u>Clearing and Grubbing Subcontractor</u> is responsible for supplying all services (including labor), equipment, and material required to clear the geophysical survey area.

3.0 FIELD INVESTIGATION ACTIVITIES

This section addresses the field investigation and sampling operations to be conducted at the Cornell-Dubilier Site. An overview of quality assurance/quality control (QA/QC) requirements and procedures, presented in detail in the QAPP (Part C), and a summary of the number, matrix and types of samples to be acquired during the Phase I Field investigation is also provided in this section.

Field investigation activities to be conducted during the RI investigation include:

Mobilization and Demobilization

Site Survey

Geophysical Survey

Soil Gas Survey

Dye Testing

Building Interior Sampling [Floor Dust]

Test Pit Investigation

Wetlands and Habitat Delineation

Off-Site Residential/Commercial Property Soil Sampling

On-Site Surface Soil Sampling

On-Site Subsurface Soil Sampling

Soil Sample Field Screening

Hydropunch Sampling

Monitoring Well Installation and Development

Drainage System Sampling

Building Interior Sampling [Air] (Phase II Investigation)

Ecological Resources Reconnaissance (potential Phase II Investigation)

Sediment Sampling (potential Phase II Investigation)

Surface Water Sampling (potential Phase II Investigation)

Biota Sampling (potential Phase II Investigation)

Water Level Measurements

Groundwater Sampling

Aquifer Testing (Phase II Investigation)

Decontamination

The geophysical and soil gas survey areas for the Reconnaissance Phase are shown in Figure 2-1. The approximate sample locations for the Reconnaissance Phase and the Phase I Investigation are provided in Figure 2-2. The number, type and location of samples for the Phase II Field Investigation will be determined subsequent to the Reconnaissance Phase and Phase I Investigation events, and will be provided in an Addendum to this plan.

Each field activity will be conducted by field personnel wearing appropriate personal protective equipment and using proper health and safety equipment as outlined in the EHS Plan.

All wastes generated during field investigation activities will be collected in appropriate drums or storage tanks prior to off-site disposal by a licensed subcontractor.

3.1 SAMPLE SUMMARY

3.1.1 <u>Sample Identification System</u>

Each sample will be designated by an alpha-numeric code that will identify the Site and matrix sampled, and will contain a sequential sample number. Site-specific procedures are provided in Section 5.0 of the QAPP (Part C) and are summarized below.

The site identifier code will be "CDE" for the Cornell-Dubilier Electronics Superfund Site. Each matrix sampling location will be identified with a location type letter code, indicating the type of sample (i.e., SB for soil boring; GW for groundwater; etc.), and with the name and/or number that depicts the specific location. Soil samples will be numbered by the depth in feet or inches (surface soil and building boring soil samples only) at the top of the sample (e.g., the sample collected at 2 to 4 feet would be identified as "02"). Sampling events, or rounds, will be numbered in sequence beginning with "01".

For example, a surface soil sample collected from location SS01 would be CDE-SS01-00. CDE-MW07-04 would denote the 4- to 6-foot sample from boring location MW07. A sample collected from monitoring well MW02 during the first round of groundwater sampling would be CDE-GW02-01, while one collected during the second groundwater sampling round would be CDE-GW02-02. The first field blank sample collected for the monitoring well boring portion of the project would be CDE-MWFB-01, the second CDE-MWFB-02, etc.

3.1.2 Sample Analytical Requirements

Table 3-1 summarizes the proposed analytical program for the Reconnaissance Phase and the Phase I Investigation. Additional information on the number of samples and duplicates, matrix, sampling device, sample container requirements, sample preservation, holding times, and analyses is provided in Section 6.0 of the QAPP (Part C).

3.1.3 <u>Sample Preservation, Packaging and Shipping</u>

All applicable samples will be preserved prior to shipment. Preservation of the samples will be checked for pH prior to sealing by pouring a small quantity of the preserved sample over pH paper, except for volatile organic samples. The pH of volatile organic samples will be checked on an additional sample aliquot utilized to determine if the amount of 1:1 HCL preservative added for the actual volatile organic sample is correct, as per USEPA Region II procedures. Field and trip blanks are to be preserved in the same manner as aqueous environmental samples. All samples will be placed immediately in a cooler with ice to preserve them at 4°C and will be kept at this temperature at all times.

Environmental samples being analyzed at an off-site laboratory will be properly packaged and shipped for analysis. Chain of custody forms, sample labels, custody seals, and other sample documents will be completed as specified in Section 5.0 of the QAPP (Part C). Copies of the chain of custody forms will be retained on-site.

TABLE 3-1 SUMMARY OF ANALYTICAL PROGRAM - RECONNAISSANCE PHASE AND PHASE I INVESTIGATION

Sample Type	Target Volatile Organic Compounds	TCL Volatile Organic Compounds	TCL Semi- Volatile Organic Compounds	TCL Pesticide/PCB Compounds	TCL PCB Compounds	PCB Congeners	Low Concentration Volatile Organic Compounds	Low Concentration Semi-Volatile Organic Compounds	Low Concentration Pesticide/PCB Compounds	Low Concentration PCBs	TAL Metals	Cyanide	Geotechnical Parameters	Haloacetic Acids	Water Quality Parameters	Field Measurements
SOIL GAS	225 (12)							,,				-				
SOILS																
Test Pit		10 (1)	10 (1)	10 (1)							10(1)	10 (1)				
Residential/Commercial					849 (43)											
Surface		21 (2)	21 (2)	21 (2)		3 (1)					21 (2)	21 (2)	21 (2)*			
Subsurface Well Borings		44 (3)	44 (3)	44 (3)		3 (1)					44 (3)	44 (3)	44 (3)			
Subsurface Building Borings		144 (8)	144 (8)	144 (8)							144 (8)	144 (8)				
GROUNDWATER																
Test Pit							10 (1)	10 (1)	10 (1)		10 (1)	10 (1)				
Hydropunch							11 (1)			11 (1)						
Phase 1 Wells [Round I]						3 (1)	11 (1)	11 (1)	11 (1)		11 (1)	11 (1)		11 (1)	11 (1)	11
DRAINAGE SYSTEM											. "					
Standing Water							5 (1)	5 (1)	5 (1)		5 (1)	5 (1)				
Sediment		5 (1)	5 (1)	5 (1)						-	5 (1)	5 (1)				
BUILDING INTERIOR (FLOOR DUST)					24 (2)						24 (2)					
BLANKS	1															
Field			48	48	44	8	21	10	10	11	66	58				
Drilling Water							2	. 2	2		2	2		1		
Trip							21									
DI Water							2	2	2		2	2				
Total	225 (12)	224 (15)	272 (15)	272 (15)	917 (45)	17 (3)	83 (4)	40 (3)	40 (3)	22 (1)	344 (20)	312 (18)	65 (5)	. 11 (1)	11 (1)	11

- The number provided in parentheses denotes the number of field environmental duplicate samples. The table does not include laboratory QA/QC samples.

 Low concentration volatile organic compound, semi-volatile organic compound, and pesticide and PCB parameter list stated in OLC02.1 or latest revision.

 TCL volatile organic compound, semi-volatile organic compound, and pesticide and PCB parameter list stated in OLM04.2 or latest revision.

 Metal parameter list stated in ILM04.1 or latest revision.

 Geotechnical parameters include grain size and/or total organic carbon.

 Water quality parameters include total organic carbon, dissolved organic carbon, total suspended solids, total dissolved solids, ammonia, nitrate-nitrite, total phosphorus, hardness, chloride, chlorite, and bromate. The number of QA/QC blanks are estimated on the basis of one trip blank per day when aqueous VOC samples are collected, and one field blank per decontamination event (not to exceed one per day per type of sampling equipment).
- *TOC only.

3.1.4 Sample Documentation

In the support zone, a sample logbook and site logbook will be maintained. The sample logbook is a loose-leaf notebook containing sample log sheets, which will be filled out for each sample from the information recorded in the field notebook. A bound weatherproof site logbook will be kept by the FOL or his/her designee. This site logbook shall contain an abbreviated version of the notes listed in the team and individual field notebooks.

The sample team or any individual performing a particular sampling activity is required to maintain a field notebook. This field notebook will be a bound weatherproof logbook that shall be filled out at the location of sample collection immediately after sampling. It shall contain sample particulars including sample number, collection time, location, descriptions, methods used, daily weather conditions, field measurements, name of sampler, and other site-specific observations. It shall also contain any deviations from protocol, field observations and other site-specific information determined to be noteworthy.

In addition, team members will use appropriate forms applicable to the field activities. These include boring logs, monitoring well construction diagrams, well purge data sheets, and rig shift reports, as presented in Section 5.3.3 of the QAPP (Part C).

3.2 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP, Part C of the Field Operations Plan, provides the details of the QA/QC requirements for all activities at the Cornell-Dubilier Site. Excerpts of the QA/QC procedures most relevant to the field sampling investigation are proved below.

3.2.1 Field Instrument Calibration and Preventive Maintenance

Equipment to be used each day shall be calibrated prior to the commencement of the days activities. In addition, all field instruments must undergo response verification checks at the end of the day's activities and at any other time that the user suspects or detects anomalies in the data being generated. Field instruments will be calibrated and maintained in accordance with the manufacturer's manual specifications, and all calibration and maintenance information shall be documented. Section 8.0 of the QAPP provides a detailed description of calibration and maintenance procedures.

3.2.2 **QA/QC Sample Collection**

QA/QC samples will be collected during the field investigation. These samples include field blanks, trip blanks, drilling water blanks, deionized water blanks, cooler temperature blanks, and environmental duplicate samples. Information on potential cross-contamination and sampling technique reproducibility are provided by these samples. Descriptions of and guidance on field QA/QC samples is presented in Section 9.1 of the QAPP.

3.2.3 Analytical Data Handling, Validation and Reporting

Standard methods and references will be used as guidelines for data handling, reduction and reporting (see Section 10.0 of the QAPP for further information). All data for the project will be compiled and summarized with an independent verification at each step in the process to prevent transcription/ typographical errors.

The results of the sampling and analytical program will undergo a systematic data validation. The data validation will be performed based on an evaluation of USEPA Region II Data Validation Standard Operating Procedures (SOPs), method-specific QA/QC information, and/or the best professional judgement of the validator. Non-conforming QA/QC results will be evaluated with respect to their implications for data reliability and usability (see Section 10.2 of the QAPP for further information).

3.3 SAMPLING PROGRAM

3.3.1 Mobilization and Demobilization

This field investigation activity consists of field personnel orientation, equipment mobilization, the determination of sampling locations, and demobilization. Each field team member will attend an on-site orientation meeting to become familiar with the history of the site, health and safety requirements, and field investigation procedures.

Equipment mobilization will entail the ordering, purchase, and if necessary, fabrication of all sampling supplies and equipment needed for the field investigation. An inventory of available Foster Wheeler Environmental supplies/equipment will be conducted prior to initiating field activities, and all additional equipment required will be secured. A field office trailer will be set up and necessary utility hookups will be made as part of the mobilization effort.

For the Reconnaissance Phase, grid locations for the geophysical and soil gas surveys will be determined prior to field operations (see Figure 2-1). In addition, locations for the test pits will be staked. Building interior and exterior sumps, pits, drains, catch basins, etc. will be located. On-site production wells will also be located, if possible, and their condition assessed.

During mobilization for the Phase I Investigation, locations for the surface soil samples, monitoring wells, sediment/surface water samples, etc. (as applicable) will be staked at the start of the operations (see Figure 2-1 for approximate sampling locations). These locations will be finalized from information obtained during the Reconnaissance Phase, and measured from existing landmarks prior to surveying.

Phase II Investigation mobilization will consist of staking all additional locations (as applicable), prior to sampling. The types and locations of samples to be collected during this phase will be determined from Reconnaissance Phase and Phase I Investigation data. Prior approval of the additional locations will be obtained from USEPA before commencement of operations.

Equipment and personnel will be demobilized at the completion of each phase of field activities as

necessary. Equipment demobilization may include (but will not be limited to) sampling equipment, drilling subcontractor equipment, and field office trailer and utility hookups. Demobilization will also consist of site-area clean-up, staging and inventory of investigation-derived wastes, and organization of investigation records.

3.3.2 Site Survey

Vertical control will be established to conform with the National Geodetic Vertical Datum (NGVD) of 1988. Establishment of vertical control benchmarks shall be performed to third-order accuracy with a precision of 0.01 foot by utilizing existing benchmarks. Horizontal control will be established based upon New Jersey State Plane Coordinate System (North American Datum (NAD) of 1983). Establishment of horizontal control benchmarks will be performed to third-order accuracy with a precision of 0.1 foot by utilizing existing benchmarks.

General boundaries and building locations of the residential/commercial properties to be sampled will be surveyed, during the Reconnaissance Phase, in preparation for determining applicable surface soil sampling grids. GPS may be used for the residential survey depending on field conditions. In addition, survey information for the Site proper will be updated, and the soil gas survey sampling grid will be established.

During the Phase I and II Investigations, the horizontal location of all sample locations will be surveyed to the nearest 0.1 foot. In addition, the vertical elevation of the ground surface adjacent to each of the sampling locations will be surveyed to the nearest 0.1 foot. The vertical elevation of the outer casing and inner well casing will be surveyed to the nearest 0.01 foot for the monitoring wells. The surveyor will make a black mark or notch on the highest point of the inner casing. Elevations will be recorded at this mark, and all water level measurements will be determined from this point.

All site survey data will be digitalized and computerized for development of Geographic Information System (GIS) map figures.

3.3.3 Geophysical Survey

A geophysical investigation to delineate areas of possible subsurface disposal will be performed in the central and southwestern portions of the Site (see Figure 2-1). Approximately 12 acres of the property will be divided into sub-plots and will be fully surveyed using two geophysical methods: magnetometry and frequency-domain electromagnetic induction (FDEMI). In addition, a geophysical investigation will be performed to assist in locating any on-site production wells.

Geophysical data will be collected using two instruments: a Geometrics G-858G magnetometer (configured as a vertical gradiometer and including a continuous-recording base station) and a Geonics EM31-MK2 ground conductivity meter. Positional data will be acquired utilizing a Leica System 530 GPS system for navigational control. GPS data will be captured at one second intervals, utilizing the real-time kinematic (RTK) mode, which provides centimeter-grad positional accuracy.

The geophysical survey will be conducted using the following data collection procedure (Procedure #1):

- 1. Clear the surface of the area to be surveyed (performed by clearing and grubbing subcontractor). This may include cutting underbrush to a height less than 1 foot, removing trees less than 3 inches in diameter, removing brush, and mowing grasses greater than 2 feet in height. A sweep for metal objects on the ground surface will be conducted, and surficial metal identified will be noted and removed from the area of investigation.
- 2. Establish survey control within the investigation area. Survey markers will be installed both within and around the boundary of the survey area, and these points will be utilized to establish and calibrate the GPS base station.
- 3. Acquire data from a test line prior to commencement of each day's activities. This test line will be performed over a known subsurface object or over a pre-placed object (such as a steel pipe).
- 4. Set up magnetometer base station.
- 5. Begin survey at the southwest corner of the investigation area (or a subdivision of the investigation area) and progress northward (or eastward) until the area boundary or a major obstruction is encountered. Magnetometry data will be acquired at a sampling rate of approximately 10 samples per second, which translates to a sample density of 1 sample every 0.1 meters (0.33 feet) based on an average walking pace. FDEMI conductivity readings will be acquired at a sampling rate of approximately 2.5 samples per second, which translates to a sample density of 1 sample every 0.4 meters (1.3 feet) based on an average walking pace. GPS data will be acquired concurrently with geophysical data, at a rate of 1 sample per second.
- 6. After reaching the boundary or obstruction, reverse direction, and acquire survey data in the opposite direction along a parallel line at the following line spacing: 1 meter for magnetometer readings and 2 meters for conductivity readings.
- 7. Continue acquiring data in opposing directions, until the entire investigation area has been covered.
- 8. Acquire several lines of geophysical data for a known linear metallic object placed upon the ground surface. This procedure will allow for accurate time shifting of geophysical data necessary for merging the geophysical and GPS data.
- 9. Repeatedly (at least 3 times per day) revisit a calibration station and collect data with the EM31, in order to provide for an instrument drift correction.
- 10. Acquire data from the test line subsequent to each day's activities, for quality assurance comparison.

The geophysical data will be processed and interpreted using manufacturer-supplied software, Foster Wheeler Environmental-developed proprietary software, and the GEOSOFT Oasis Montaj Data Processing and Analysis System. Data will be interpolated to New Jersey State Plane coordinates, filtered as appropriate, extrapolated to a grid system, and displayed on maps of the Site.

3.3.4 Soil Gas Survey

A soil gas survey will be performed around the Site to delineate areas of possible subsurface disposal and potential source areas. A sampling grid of approximately 100 feet by 100 feet will be utilized across a majority of the Site, with soil gas samples collected at the grid nodes. Additional soil gas samples will be collected at 25 foot by 25 foot grid nodes in the vicinity of the potential test pit locations, at 50 foot by 50 foot grid nodes around the east-northeast Site buildings, and at any other additional areas determined during the field investigation (e.g., potential discharge locations determined from dye testing, elevated levels present during real-time sampling, etc.). At this time, an estimated 225 soil gas sample locations is proposed (see Figure 2-1). Actual sampling locations will be adjusted in the field to ensure sampling in vegetated areas between on-site buildings. A field gas chromatograph (GC) will be used to determine sample screening concentrations of volatile organic compounds (VOCs). Water table, barometric, and temperature changes can vary the results.

The active soil gas survey will be performed by a subcontractor under the supervision of Foster Wheeler Environmental. The Site Geologist, or his designee, will be present on-site with the subcontractor's crew at all times, to ensure that the soil gas survey is performed following the SOP detailed below, and to resolve any specific problems encountered at the Site. Foster Wheeler Environmental will conduct an oversight of the soil gas survey activities including:

- Location of the soil gas survey locations;
- Comparison of the field GC data with applicable quality assurance data to determine acceptability of results;
- Determination of the need for additional or a reduction in the number of soil gas survey points;
- Supervision of the topographic surveying to locate the sampling points;
- Review of the subcontractor's data analysis and evaluation from the soil gas survey report; and
- Recommendation for movement of the Phase I Investigation locations based on the soil gas survey results.

Each soil gas sample will be collected and analyzed in the following manner (Procedure #2), which is based on USEPA ERT SOP #s 2042 and 2109 (provided in Attachment E):

- 1. Record ambient air temperature and barometric pressure.
- 2. Drill a hole into the soil either by hand auger, rotary hammer, or driven rod (as conditions dictate), to roughly 4 to 5 feet in depth. The depth may be reduced based upon conditions at the Site at the time of sampling; all changes will be noted on Field Change Requests (see Section 13.0 of the QAPP).

- 3. Insert a probe, slightly smaller in diameter than the borehole, into the hole, and the hole will be sealed by packing soil around the expansion bulb at the probe top. The probe assembly will be selected by the subcontractor, with assistance from the field geologist, to best suit Site conditions. A typical assembly would consist of a 1/4-inch O.D. stainless steel probe, approximately 5-feet in length, and Teflon tubing, with a reducing tee and cap attached to the fitting.
- 4. Ensure/test vacuum with a gauge attached to the probe.
- 5. Extract soil gas through the probe via a vacuum pump connected to the tubing. Purge approximately 3 to 5 sample volumes prior to sampling to remove any introduced ambient contamination.
- 6. Remove the soil gas sample with a 500 uL gas-tight syringe inserted into the tubing in front of the pump. This volume is adequate for achieving the required detection limit (25 ug/L). If necessary, due to field conditions, the sample can be stored in a pressurized container.
- 7. Immediately inject the sample into the calibrated GC (see Step 7), and plot the chromatogram. Identify and quantify, based on standard peaks, any contaminants present in the soil gas sample.
- 8. Calibrate the GC prior to sample analysis. Initial instrument calibration should consist of a minimum of 3 concentration points (5 points are preferred), to demonstrate the working range and linearity. Linearity will be assumed if the ratio of the area response to the amount injected is constant over the working range (i.e., less than 20 percent Relative Standard Deviation). In addition, an initial verification of a less than 25 ug/L detection limit shall be run.
- 9. Check the sample probe for contamination between each sample location, by drawing ambient air through the probe via the pump, and checking that the response is not greater than background levels. If necessary, decontaminate the probes using methanol and deionized water, and then air drying.

As stated in the QAPP (Part C of the FOP), for the soil gas survey sampling, continuing calibration standards will be run at the beginning and end of each sampling day, and a method blank shall be analyzed every 12 hours and after any highly contaminated samples to check for carry-over. In addition, an environmental field duplicate will be chosen every 20 samples.

3.3.5 Dye Testing

During the Reconnaissance Phase of the field investigation, the sumps, pits, drains, etc. within the on-site buildings will be located, as will the locations of catch basins, drains, outfalls, etc. around the buildings and on the Site. From these locations, potential discharge points/pathways will be approximated. If historic drawings of the buildings and/or of the terminus of the drainage system are available, this information will be added to the approximation. Dye testing will be performed, as necessary, to determine actual discharge locations. Prior to any dye testing activities, potentially

affected townships and publically owned treatment works (POTWs) will be notified. The number of drainage system points scheduled for dye testing has been estimated at 5; however, this number may change based on the location and condition of the pits, drains, basins, etc. and the amount of information available on and level of approximation of the discharge pathways.

Dye testing will be performed as follows (Procedure #3):

- 1. Locate potential discharge points for the drain, pit, etc. being tested. Position field personnel at these points.
- 2. Place 1 to 3 colored, biodegradable dye tablets into the drain, pit, etc.
- 3. Add sufficient water to the drain, pit, etc. to dissolve the dye tablets and to begin drainage flow.
- 4. Note locations of dye-colored discharge in a field logbook and on a facility map of the Site.

3.3.6 <u>Building Interior Sampling [Floor Dust]</u>

Floor dust sampling will be performed during the Reconnaissance Phase in the 24 on-site buildings to determine levels of indoor contamination. For each building, one (1) sample will be collected every 10,000 square feet or portion thereof, for at least one (1) sample per building. Samples will be analyzed for TCL PCBs and TAL metals. Particulate matter will be withdrawn from carpets and/or bare floors by a flowing air stream passing through a sampling nozzle at a specific velocity and flow rate. Particles approximately 5 micrometers (um) mean aerodynamic diameter and larger are separated and collected in a sampling container for transport and laboratory analysis. The sampling apparatus may be acquired from commercial vendors (such as CS₃ Incorporated) or constructed.

Floor dust samples will be collected following ASTM Method D5438-94 and as outlined below (Procedure #4):

- 1. Pretest the sampling apparatus for leaks by placing a piece of cardboard beneath the nozzle and switching on the suction source. The flow Magnehelic gage should read 5 Pa $(0.02 \text{ in } H_2O)$ or less to ensure that the system is leak-free. If any leakage is detected, the sampling system shall be inspected for the cause and corrected before use.
- 2. Place two (2) measuring tapes parallel on the carpet/floor on either side of the area to be sampled. The tapes should be placed between 0.5 and 1.5 meters (m) apart, and taped to the carpet/floor approximately every 30 centimeters (cm).
- 3. Place the sampling apparatus in one corner of the sampling area, and adjust the flow rate and pressure drop accordingly (see following table). For bare floors, the height of the nozzle above the floor should be approximately 1 mm (a US penny under the nozzle lip will hold it at this height).

Flooring Type	Flow Rate	Nozzle Pressure Drop
Plush Carpet	9.5 L/s (20 cfm)	2.2 kPa (9 in H ₂ O)
Multi-level Carpets	9.5 L/s (20 cfm)	2.2 kPa (9 in H_2O)
Shag Carpets	9.5 L/s (20 cfm)	2.2 kPa (9 in H_2O)
Level loop Carpets	7.8 L/s (18 cfm)	$2.5 \text{ kPa } (9 \text{ in H}_2\text{O})$
Bare Floor	9.5 L/s (20 cfm)	

- 4. Clean the wheels and nozzle lip of the sampler with a clean laboratory tissue immediately before sampling.
- 5. Begin sampling by moving the nozzle of the apparatus between the ends of the measuring tapes. Move the sampler back and forth four (4) times on the first "strip" of carpet/floor at a rate of 0.5 m/s. The width of a strip will be defined by the width of the sampling nozzle, approximately 13 cm for the CS₃ Incorporated sampler.
- 6. Angle over to the next "strip" on the carpet/floor gradually during the fourth pass, and repeat the four double passes.
- 7. Repeat Steps 5 and 6 until approximately 0.5 m² have been sampled <u>and</u> approximately 6 to 8 grams (g) of dust have been collected. (As a rough estimate, the collection of dust to a depth of 6 millimeters (mm) in a 55-mm diameter catch bottle corresponds to between 6 g and 8 g.) Hair, carpet fibers, and other large objects should be excluded from the sample when estimating the quantity collected.
- 8. If there is less than 6 mm of dust in the catch bottle, continue to sample additional 0.5 m² areas following Steps 5 through 7 until an adequate sample is collected.
- 9. Switch off the vacuum, remove catch bottle with sample, and record dimensions of sampled area.
- 10. Transfer the sample from the catch bottle to the following:
 - For organics, transfer the sample to a piece of aluminum foil that has been cleaned by washing with methanol or hexane. Fold the foil into a small package, keeping the dust in the middle of the foil. Place the foil pouch in a glass jar, and cover the jar opening with another piece of pre-cleaned foil. Secure the lid to the jar. Seal the seam of the jar lid with polytetrafluoroethylene tape. Place a label on the outside of the jar.
 - For metals, transfer the sample to a polyethylene "zipper" seal sample bag. Seal the "zipper" and tape the seal with any tape that will adhere well to the bag. Place a label on the bag.
- 11. Complete sample sheets, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 12. Place analytical samples in a cooler for shipment and chill to 4°C.

3.3.7 Test Pit Investigation

A test pit program will be performed to determine the physical nature and location of buried waste (such as electrical components) in the central portions of the Site. As indicated on Figure 2-1, approximately 10 test pits will be excavated to a maximum depth of 10 feet bgs, to provide a visual characterization of Site contamination. The test pits shall be approximately 10 feet in length. Final test pit depths and lengths will be determined by the Site Geologist, and will depend on the horizontal and vertical extent of buried waste or visually contaminated soils. The locations presented on Figure 2-1 may be modified based on the results of the geophysical and soil gas surveys. Collection of soil and/or groundwater samples may be performed during the test pit program as necessary and appropriate (e.g., stained soil, groundwater with sheen, odors, elevated FID/PID readings, etc.). At this time, up to a maximum of 10 soil and 10 groundwater samples will be utilized for estimation. The soil samples would be analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), TCL pesticides/PCBs, and Target Analyte List (TAL) metals and cyanide. Analyses for the groundwater samples would include low concentration VOCs, low concentration SVOCs, low concentration pesticides/PCBs, and TAL metals and cyanide.

The following procedure will be used for test pit excavation and sampling as necessary and appropriate (Procedure #5):

- 1. Using a backhoe, remove the upper 2 feet of soil from an area approximately 5 feet by 5 feet square, and place to one side of the excavation.
- 2. Continue the excavation downward using the backhoe, placing the soils on the opposite side of the excavation. Extend the pit vertically and horizontally until the appropriate depth and width are obtained.
- 3. If visibly contaminated soil is present (e.g., staining), collect a soil sample from that interval layer. A sample from near the surface may be obtained using a decontaminated stainless steel hand auger (see Procedure #9B), sampling corer, shovel or scoop (see Procedure #8). A sample from a deeper depth should be collected using the bucket of the backhoe to obtain a sample from the base of the excavation, and then a sampling corer and/or decontaminated shovel or scoop shall be used to separate the soil into appropriate containers (see Procedure #8). Personnel shall not enter an excavation if it is more than 4 feet deep.
- 4. If groundwater with a sheen or odors is encountered, collect a water sample. A sample from less than 4 feet in depth may be obtained by direct fill (if possible) or by using a decontaminated stainless steel scoop. A sample from a deeper depth should be collected using a stainless steel beaker clamped to a pole. Care should be exercised when pouring the water into the appropriate sample containers as not to aerate the sample. Personnel shall not enter an excavation if it is more than 4 feet deep.
- 5. Sketch a map of the trench showing the location (horizontally and vertically) of any stained soil layers, samples, buried wastes, etc. in the field notebook and/or on a test pit record form. Any identifying marks on buried equipment within the test pit shall also be noted.

- 6. After completion of the trench or at the end of the day, whichever is more frequent, backfill the test trench(es). The soils from the deeper portion of the trench shall be returned to the trench first. If a trench was not completed and is backfilled at the end of a day, it may be restarted the next day from the point at which excavation ceased.
- 7. Mark the boundaries of the test pits and the ground surface location(s) of any soil/groundwater samples with stakes for subsequent surveying. Perform re-vegetation of the area as necessary and required.

3.3.8 Wetlands and Habitat Delineation

A delineation of wetland areas within the property boundaries of the Cornell-Dubilier Site or immediately adjacent will be conducted pursuant to the 1989 Federal Manual routine on-site determination method (Federal Interagency Committee for Wetland Delineation, 1989), and in accordance with the following procedure (Procedure #6A):

- 1. Conduct preliminary data gathering and synthesis including review of appropriate site location maps, U.S. Fish and Wildlife Service National Wetland Inventory (NWI) Maps, U.S. Soil Conservation Service County Soil Survey information, and pertinent hydrological data.
- 2. Conduct a site reconnaissance consisting of an initial visual assessment of vegetation and hydrology, and selection of sampling locations.
- 3. Characterize vegetation, soil and hydrology indicators at selected sample locations. Dominant plant species and estimated areal cover will be determined and recorded by stratum: tree, shrub, herb and vine. Soil cores will be extracted to a depth of 20 inches, where possible, to confirm the presence or absence of hydric indicators, and observations will be recorded in standard log format. Hydrologic indicators or lack thereof will also be recorded.
- 4. Mark the delineated wetland boundary at 50 to 75 foot intervals (depending on line of sight) with colored flagging. Flagging for each delineated wetland boundary will be colored differently and marked with letter identifier and numbered sequentially (e.g., A-1, A-2, A-3, etc.). In areas between stations, the boundary will be flagged on the basis of perceived changes in vegetation or topography. Approximate locations of flagged boundary markers and sample stations will be located on a site drawing.
- 5. Take photographs at selected sample locations, which will be indicated on the site drawing showing wetland boundaries. The direction in which each photograph was taken will also be noted.

Delineated wetland boundary flags and sample station markers will be located with differential GPS referenced to Universal Transverse Mercator coordinates. Foster Wheeler Environmental will

coordinate with the surveying firm, to relay specific requirements and properly identify upland/wetland boundaries. Once the wetlands delineation survey is completed, the accuracy of the surveyed boundaries will be verified.

A report detailing the results of the wetlands and habitat delineation will be prepared. The report shall include a description of the site, the methodologies employed, information obtained from maps and literature sources, a compilation of the vegetation species recorded, photographs, soil logs and data forms.

In addition to performing the wetland delineation and boundary mapping, a qualitative vegetation habitat survey will be performed to identify terrestrial habitats. The habitat survey will consist of identifying vegetation communities present within the Site study area, which consists of the Cornell-Dubilier Electronics property and the Bound Brook corridor, i.e., the area within the banks and immediately adjacent to Bound Brook, from the Cornell-Dubilier Electronics Property to New Market Pond. An in-office review of aerial photographs and existing maps will be reviewed to identify vegetation communities present within the study area. The communities will be verified during the Reconnaissance Phase delineation effort. During the field investigation, representative sample stations will be recorded within the vegetation communities. Vegetation communities will be characterized by identifying and recording dominant vegetation within four stratum: tree, woody shrub/sapling, herbs, and woody vines. Incidental wildlife species observed during the field effort will also be recorded.

Based on the information collected from the photos and maps and the data collected during the field investigation, a vegetation covertype map will be compiled with the approximate boundary of each covertype depicted on the map. A report documenting results of the on-site field investigation will also be prepared, and will include a review of information gathered from aerial photographs and maps, description of vegetation within each community and a compilation of vegetation species recorded at each sample station.

During the Reconnaissance Phase, a threatened and endangered species documentation search within the Cornell-Dubilier Electronics Superfund Site study area will be requested from NJDEP, Natural Heritage Program; and United States Fish and Wildlife Service (USFWS).

An in-office delineation of wetlands and floodplains adjacent to Bound Brook, downstream of the Site property, to New Market Pond (i.e., the Bound Brook corridor) will be conducted in accordance with the following procedure (Procedure #6B):

- 1. Conduct preliminary data gathering and synthesis including review of appropriate site location maps, U.S. Fish and Wildlife Service NWI Maps, New Jersey State Freshwater Wetland Maps, and aerial photographs. Establish the flood hazard area, 100-year floodplain and 500-year floodplain of the Bound Brook corridor by reviewing NJDEP flood hazard maps and Federal Emergency Management Agency (FEMA) flood insurance rate maps.
- 2. Approximate wetland and floodplain boundary lines on a map.

- 3. During the site reconnaissance, verify the accuracy of the wetland boundary map during a visual assessment of vegetation and hydrology.
- 4. Correct map if differences are observed during the visual verification assessment.

3.3.9 Off-Site Residential/Commercial Property Soil Sampling

Surface (0 to 2 inch depth) and shallow subsurface (16 to 18 inch depth) soil samples will be collected from a total of 36 residential and commercial properties located in the vicinity of the Site. Sampling grids will be established on the properties, as listed on Table 3-2, to facilitate collection of the soil samples for PCB analysis (see Section 3.3.2), and these sampling grids will be submitted to USEPA for approval prior to sample collection.

A total of 659 surface soil samples will be collected using stainless steel scoops/spoons, and placed directly into the sample container. A total of 190 subsurface soil samples will be collected on the properties by hand auger. The subsurface soil will be placed in stainless steel bowls for homogenization prior to sample collection. Samples shall be labeled and iced immediately after collection, and all surface and subsurface residential/commercial property samples will be analyzed only for TCL PCBs.

Residential/commercial property surface soil sampling will be conducted in accordance with the following procedure (Procedure #7A):

- 1. Using a decontaminated stainless steel spoon, spatula or trowel, scrape away surficial organic material (grass, leaves, etc.).
- 2. Collect the sample for TCL PCB analysis from the undisturbed soil (0 to 2 inches bgs), by direct fill of the sample container, using the decontaminated spoon, spatula or trowel.
- 3. Complete sample log, label, custody seal, and chain of custody form. Record sample information in the field notebook.
- 4. Place the analytical sample in a cooler for shipment and chill to 4°C.

If necessary, due to landscaping activities by a property owner which would modify the surface soils (i.e., the addition of fill soil on top of native surface soils), a hand auger (Procedure #7B) may be used to sample the appropriate soil interval.

Subsurface soils from residential/commercial properties will be collected by hand auger in accordance with the following procedure (Procedure #7B):

1. Using a decontaminated hand-driven, 4-inch diameter stainless steel bucket auger, begin turning the auger in a clockwise direction. Continuing turning until the desired sampling depth (16 to 18 inches bgs) is obtained.

TABLE 3-2
SUMMARY OF RESIDENTIAL/COMMERCIAL PROPERTY
SOIL SAMPLING LOCATIONS

Location	Number of Surface Soil Samples	Number of Subsurface Soil Samples		
Block 256, Lot 11	20	5		
Block 335, Lot 1	19	5		
Block 335, Lot 8.01	13	5		
Block 338, Lot 1	19	5		
Block 338, Lot 4	19	5		
Block 338, Lot 9	18	5		
Block 339, Lot 9	18	5		
Block 339, Lot 4	18	5		
Block 339, Lot 15.01	19	5		
Block 340, Lot 7	19	5		
Block 340, Lot 4.01	11	5		
Block 341, Lot 8	20	5		
Block 342, Lot 13	20	5		
Block 343, Lot 13	20	5		
Block 345, Lot 16	20	5		
Block 347, Lot 8.01	20	5		
Block 348, Lot 11	20	5		
Block 349, Lot 2	20	5		
Block 355, Lot 8	20	5		
Block 359, Lot 1	19	5		
Block 364, Lot 1	19	5		
321 Spicer Avenue	19	5		
405 Spicer Avenue	19	5		
408 Hamilton Blvd.	19	5		
417 Hamilton Blvd.	19	5		
123 Delmore Avenue	0	20		
334 Hancock Avenue	20	5		
312 Fred Allen Drive	20	5		
308 Fred Allen Drive	20	5		
213 Schillaci Lane	20	5		
221 Schillaci Lane	20	5		
223 Lowden	20	5		
232 Lowden	20	5		
230 Oakmoor	20	5		
251 Oakmoor	20	5		
South Plainfield Diner (address not available)	12	0		
Total	659	190		

- 2. Remove the auger from the hole, and transfer the soil sample into a decontaminated stainless steel bowl or pan.
- 3. Repeat Steps 1 and 2 until sufficient sample volume is obtained. Additional soil shall be collected from a location immediately adjacent to the first sample.
- 4. Homogenize the soil in the stainless steel bowl, using a decontaminated stainless steel spatula or spoon, and then fill the sample container for TCL PCB analysis.
- 5. Complete sample log, label, custody seal, and chain of custody form. Record sample information in the field notebook.
- 6. Place the analytical sample in a cooler for shipment and chill to 4°C.

Following evaluation of the results obtained during the Reconnaissance Phase and from previous investigations, additional residential/commercial property areas may be sampled during the Phase II Investigation.

3.3.10 On-Site Surface Soil Sampling

As indicated on Figure 2-2, surface soil sampling (0 to 6 inches bgs, with 6 to 12 inches bgs for VOCs) will be conducted at a total of 21 Phase I Investigation locations, as follows:

- 11 overburden monitoring well locations;
- 2 locations in the northeastern portion of the Site, between the fence line and Bound Brook;
- 2 locations in the eastern portion of the Site, between the hill slope and Bound Brook; and
- 6 locations along the railroad right-of-way (the northeast boundary of the Site). [This task is dependent on USEPA obtaining access to the right-of-way property].

Surface soil sampling will be conducted using hand tools and will be logged by the Site Geologist or designee. Analytical parameters for all of the surface soil samples will include TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals and cyanide, and total organic carbon (TOC). In addition, three surface soil samples (SS02, SS03, and MW09) will be analyzed for PCB congeners.

On-site surface soil sampling will be conducted in accordance with the following procedure (Procedure #8):

- 1. Using a decontaminated stainless steel spoon, spatula or trowel, scrape away surficial organic material (grass, leaves, etc.).
- 2. Remove the upper 6 inches of soil using the decontaminated stainless steel spoon, spatula or trowel, and place the soil in a decontaminated stainless steel bowl.

- 3. Collect the TCL VOC sample from the undisturbed soil beneath (6 to 12 inches bgs) using an EnCore® Sampler (Steps 4 through 14).
- 4. Prior to collecting sample, hold coring body of EnCore® Sampler, and push plunger rod down until small o-ring rests against tabs. This will assure that the plunger moves freely.
 - Depress locking level on EnCore® T-handle. Place coring body plunger end first into open end of T-handle, aligning the two (2) slots on the coring body with the two (2) locking pins in the T-handle. Twist coring body <u>clockwise</u> to lock pins in slots. Double check that sampler is locked in place prior to use.
- 5. To collect soil sample, turn T-handle such that "T" is up and coring body is down. This positions plunger bottom flush with the bottom of the coring body; double check that plunger bottom is in position.
- 6. Using T-handle, push EnCore® Sampler into soil until coring body is completely full. When full, the small o-ring will be centered in the T-handle viewing hole.
- 7. Remove sampler from soil. Wipe any excess soil from the exterior of the coring body.
- 8. Cap coring body which it is still on T-handle. Push cap over flat area of ridge. Push and twist cap to lock in place cap <u>must be</u> seated over coring body ridges to seal sampler.
- 9. Remove capped EnCore® Sampler by depressing the locking lever on the T-handle while twisting and pulling sampler from T-handle.
- 10. Lock plunger by rotating extended plunger rod fully <u>counter-clockwise</u> until wings rest firmly against tabs.
- 11. Attach a completed label (provided with the EnCore® Sampler in the bag) to the cap on the coring body container. Place sampler in zipper bag provided, and seal bag.
- 12. Place initialed custody seal(s) over the top of the closed EnCore® bag, in such a manner that the bag cannot be opened (even partially); two or more custody seals may be needed. **Do not place custody seals directly on the EnCore® Sampler!**
- 13. Attach a completed sample tag to the bag, using tape or other method, provided that the sample tag is securely fastened to the bag and will not become dislodged in transit.
- 14. Collect an additional aliquot of soil from each sample location in a separate jar, for percent moisture determination by the laboratory (if VOC samples are shipped to a separate laboratory from the SVOC and/or pesticide/PCB samples).
- 15. Collect additional soil (sufficient volume for all parameters of interest) from the sample location area, up to a depth of 6 inches, and place in the stainless steel bowl. Homogenize this soil with the sample collected in Step 2. Separate into the appropriate containers for

- the analysis of TCL SVOCs, TCL pesticides/PCBs, TAL metals and cyanide, TOC and PCB congeners (as applicable).
- 16. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 17. Place the analytical samples in coolers for shipment and chill to 4°C.

3.3.11 On-Site Subsurface Soil Sampling

Subsurface soil sampling will be conducted at 11 locations in conjunction with the installation of the Phase I Investigation monitoring wells (see Figure 2-1). Soil samples will be obtained during drilling operations for the monitoring wells at continuous 2-foot intervals. Soil samples will be submitted for laboratory analysis only from the following depth intervals: between 0 feet and the top of weathered bedrock (depth chosen based on field observations and most elevated field screening result; see Procedure #10); at the top of weathered bedrock; between the top of weathered bedrock and competent bedrock (depth chosen based on field observations and most elevated field screening result; see Procedure #10); and at the top of competent bedrock. Additional samples may be sent from a location if field conditions require (i.e., there are 2 layers of stained soil with relatively elevated field screening results within the interval from the surface to the top of weathered bedrock), and these additional samples will be documented by a FCR. In addition, the soil sample collected in the overburden interval (unless visual and/or instrument screening indicates a significantly more contaminated sample from a deeper soil zone) in borings MW04, MW06 and MW09 will be analyzed for PCB congeners.

Subsurface soil samples will also be collected during soil boring operations in and around the 24 on-site buildings and former structures, focusing near the sumps/pits/drains/catch basins/etc. The number of locations will depend on the information obtained during the Reconnaissance Phase; however, at this time, it is estimated that an average of 3 borings will be located in/around each building, for an estimated total of 72 soil borings. Soil samples will be collected at 2 sample intervals: 0 to 6 inches beneath the concrete or other surface covering (6 to 12 inches for VOCs) and 12 to 24 inches beneath the surface covering (18 to 24 inches for VOCs). The upper interval will be obtained following Procedure #8, and the deeper interval will be sampled by hand auger (with direct collection of the TCL VOC fraction by Procedure #8, Steps 4 through 14).

Depending on the results of the Phase I Investigation, sampling of additional subsurface soil locations, either monitoring wells or soil borings, may be necessary during the Phase II Investigation. Drilling and sampling of the additional locations will likely be conducted with split-spoons, hand augers, or direct push methods. The rationale for these additional locations will be submitted to USEPA for approval prior to sampling.

Split-Spoon Subsurface Soil Sampling (Procedure #9A)

1. Drill a borehole to the desired sampling depth. Drive a split-spoon sampler into the undisturbed soil to be sampled.

- 2. Drive a decontaminated carbon steel 3-inch outer diameter split-spoon sampler with blows from 300 pound hammer falling 30 inches until either approximately 2 feet has been penetrated or 100 blows within a 6-inch interval have been applied (modified from ASTM Method D-1586-84).
- 3. Record the number of blows required for each 6 inches of penetration or fraction thereof. The first 6 inches is considered to be a seating drive. The sum of the number of blows required for the second and third 6 inches of penetration is termed the penetration resistance. If the sampler is driven less than 2 feet, the penetration resistance is that for the last 1 foot of penetration. (If less than 1 foot is penetrated, the logs shall state the number of blows and the fraction of 1 foot penetrated.)
- 4. Bring the sampler to the surface and remove both ends and one half of the split-spoon so that the recovered soil rests in the remaining half of the barrel. Place the split-spoon on clean polyethylene sheeting. Describe thoroughly the approximate recovery (length), the USCS and Burmister classifications, composition, color, moisture, etc. of the recovered soil.
- 5. Collect the TCL VOC sample immediately upon opening the sample tube, using an EnCore® Sampler (see Procedure #8, Steps 4 through 14). In addition, obtain samples for field screening (Procedure #10) directly after opening the split-spoon sampler.
- 6. Homogenize remaining soil in a stainless steel bowl, using a decontaminated stainless steel spatula or spoon. Fill sample containers for TCL SVOCs, TCL pesticides/PCBs, TAL metals and cyanide, geotechnical parameters analyses, and PCB congeners (as applicable).
- 7. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 8. Place the analytical samples in coolers for shipment and chill to 4°C.

Shallow Subsurface Soil Sampling [Hand Auger] (Procedure #9B)

- 1. Using a decontaminated hand-driven, 4-inch diameter stainless steel bucket auger, begin turning the auger in a clockwise direction. Continuing turning until the desired sampling depth is obtained.
- 2. Remove the auger from the hole, and transfer the soil sample into a decontaminated stainless steel bowl or pan.
- 3. At 18 inches below the covering, collect sample for TCL VOC analysis in accordance with Procedure #8, Steps 4 though 14.
- 4. Repeat Steps 1 and 2 until sufficient sample volume and/or a depth of 24 inches below the covering is obtained. Additional soil, if necessary, shall be collected from a location immediately adjacent to the first sample.

- 5. Homogenize the soil in the stainless steel bowl, using a decontaminated stainless steel spatula or spoon. Fill sample containers for TCL SVOCs, TCL pesticides/PCBs, and TAL metals and cyanide analyses.
- 6. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 7. Place the analytical samples in coolers for shipment and chill to 4°C.

Geoprobe Subsurface Soil Sampling (Procedure #9C)

- 1. Using the Geoprobe drill rig, advance carbon steel core sampler containing a 2 or 3-foot clear acetate sample tube to the desired depth into the soil. Upon removal of the sampler from the borehole, the acetate sample tube will be removed and the ends will be capped to prevent volatilization from the sample. Sample tubes will be marked with the depth interval and the sample orientation.
- 2. Place acetate sample tubes on clean polyethylene sheeting for inspection/sampling. Each sample tube will be inspected for the presence of groundwater. The tube will be cut lengthwise using a decontaminated utility knife, and the soil will be screened using an FID and PID as described in Procedure #10.
- 3. Thoroughly describe soils, including approximate recovery (length), USCS and Burmister classifications, composition, color, moisture, and any impacts noted.
- 4. Collect samples for laboratory analysis in the following order (as applicable): TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals and cyanide, and/or geotechnical parameters. The TCL VOC sample will be collected immediately upon opening the sample tube, from the middle of the soil interval, using an EnCore® Sampler (see Procedure #8, Steps 4 through 14). The remaining parameter samples will be homogenized in a stainless steel bowl prior to sample collection, and all samples will be collected using a dedicated clean stainless steel spatula or spoon.
- 5. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 6. Place the analytical samples in coolers for shipment and cool to 4°C.

3.3.12 Soil Sample Field Screening

Soil samples will be field screened using FID and PID headspace analysis in accordance with the following procedure (Procedure #10):

1. Collect representative soil samples from each sample interval, and place in two clean, unpreserved wide mouth glass jars. The jars will be filled approximately two-thirds with soil, leaving one-third empty.

- 2. The mouth of the jars will be covered with aluminum foil (shiny side out). The foil shall cover the mouth of each jar tightly and be secured with a rubber band to prevent the escape of VOCs.
- 3. After a minimum period of 5 minutes, the foil of one of the jars will be pierced using the probe of the FID, and the instrument inserted into the jar to sample the headspace.
- 4. A second reading will be made using the PID on the second jar.
- 5. Field screening readings and ambient background readings will be recorded in the field log book and on the boring log sheets at the appropriate interval.

3.3.13 Hydropunch® Sampling

Hydropunch® groundwater sampling will be conducted at 11 locations in conjunction with the installation of the Phase I Investigation monitoring wells. The Hydropunch® tool collects groundwater through the effect of *in situ* hydrostatic head, and will be utilized at the Site to obtain groundwater samples at varying depths during drilling operations to determine the vertical profiling of contaminants in the overburden aquifer and to identify possible contaminant migration pathways. The apparatus consists of a 0.010-inch stainless steel screen, approximately 5 feet in length, which is attached to a disposable drive cone. Hydropunch® samples will be collected within the unconsolidated overburden and/or weathered bedrock at 10-foot depth intervals if groundwater is encountered. Based on site geology, it is approximated at this time that one (1) sample per well boring will be collected, for an estimated total of eleven (11) Hydropunch® groundwater samples.

The following protocol was summarized from NJDEP procedures (Attachment C) and other technical guidelines (Procedure #11):

- 1. Drill a borehole to the desired sampling depth.
- 2. Place the lower check valve with attached filter screen into the bottom of the tool body and place the upper check valve in the top of the tool. Insert the disposable drive cone into the drive shoe ensuring a seal is made by the o-ring. Place sleeve over the juncture of the drive cone and drive shoe. In addition, the drill rods/casing joints must be sealed with Teflon tape on the threads, to prevent fluid from entering the rods and potentially contaminating the sample. Once together, the joints must be sealed with gas pipe tape. Another option is the use of drill rods with o-rings at the threads for sealing.
- 3. Drive the Hydropunch® sampler into the undisturbed soil to the desired depth (at least 5 feet below the water table), and pull back approximately 2 feet. A minimum of 6 inches of the body of the tool needs to be in the driven hole to provide a good annular seal.
- 4. Allow the groundwater to flow into the intake screen, past the lower check valve, and into the sample chamber (waiting time dependent on quantity of sample and estimated formation permeability; estimated at 20 minutes).

- 5. Bring the sampler to the surface. As the tool is pulled to the surface, the increase in hydrostatic head within the tool will close the two check valves.
- 6. Invert the Hydropunch® sampler and decant the groundwater through a discharge valve into sample containers. Fill sample containers for low concentration VOCs and low concentration PCBs. Preserve TCL VOC sample as per Step 4 of Procedure #16A.
- 7. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 8. Place the analytical samples in coolers for shipment and chill to 4°C.

3.3.14 Monitoring Well Installation and Development

Eleven (11) monitoring wells (MW01 through MW11) will be installed during the Phase I Investigation field program. As necessary, based on the data results, additional monitoring wells will be installed at the Site during the Phase II Investigation. A pumping well and piezometers will also be installed at the Site during the Phase II Investigation for use during the aquifer pumping test.

Drilling protocols to be followed during the program will meet NJDEP drilling procedural requirements, and were summarized from the NJDEP Field Sampling Procedures Manual (Attachment C) and other technical guidelines. Approximate locations of the Phase I Investigation wells are displayed on Figure 2-1, and the maximum anticipated depth range for each well is 60 to 65 feet below ground surface (bgs). Rationale for the selection of these locations and depths are presented in the Work Plan. However, the actual location and/or depth of any well is dependent on information obtained during the Reconnaissance Phase and during well drilling.

The hollow-stem auger (HSA) drilling method will be the preferred method for drilling within overburden and/or weathered bedrock, to the competent bedrock surface (an approximate depth of 30 feet) or auger and/or split-spoon refusal. Split-spoon subsurface soil samples will be collected by the Site Geologist (or his designee) during this procedure in accordance with Procedure #9A, and will be utilized to construct a lithologic log representative of subsurface conditions. The soil borehole will then be reamed using water rotary methods, and a temporary casing will be installed in this hole prior to rock coring.

The first 10 feet of competent bedrock will be cored and visually inspected, prior to installation of the permanent surface casing. Coring of the bedrock will continue to a depth 10 feet below encountered groundwater. The borehole will then be reamed for the open hole monitoring well. If the borehole extends to a depth greater than 25 feet below the bottom of the surface casing (i.e., the maximum open hole length allowed by NJDEP), the monitoring well will be completed using a stainless steel screen and riser.

Monitoring Wells (Procedure #12A)

Monitoring wells will be constructed and installed in accordance with the following procedure:

- 1. Advance each boring to the bedrock surface (approximately 30 feet bgs). Borehole advancement will be conducted using 6¼-inch inner diameter (ID) continuous flight hollow-stem augers in 2-foot intervals, to permit the continuous collection of subsurface soil samples with carbon steel split-spoon samplers in accordance with Procedure #9A and ASTM Method D-1586-84. Confirmation of the bedrock surface depth will be based upon split-spoon refusal.
- 2. Overbore the hole to a 12-inch diameter borehole, in which to install a temporary 10-inch carbon steel overburden casing to bedrock, utilizing an appropriately sized tri-cone roller bit.
- 3. Subsequent to temporary casing installation, continue borehole advancement into the bedrock to a depth of 10 feet below the bedrock surface, first using the rock coring method for logging (Procedure #12B) and then overboring with a 97/8-inch outer diameter (OD) tricone roller bit via the water rotary method.
- 4. Set a permanent 6-inch carbon steel casing 10 feet into the competent bedrock by the spin casing method.
- 5. Backfill the annular space around the well casing with bentonite/cement slurry to the surface. The ratio of cement to bentonite for grouting will be approximately 94 pounds of cement to every 5 pounds of bentonite as per NJDEP well installation procedures.
- 6. Remove the 10-inch temporary casing during pressure grouting (Step 5). Allow grout to cure for at least 24 hours.
- 7. Continue coring and then drilling in the borehole to the maximum anticipated total depth (i.e., 10 feet below the point where groundwater was encountered) and/or the depth where fracture zones indicate sufficient yield, first using the rock coring method and then overboring utilizing the water rotary method and a 5%-inch OD tri-cone roller bit.
- 8. Complete the one hole monitoring well as described in Procedure #12D.
- 9. If the borehole extends to a depth greater than 25 feet below the bottom of the surface casing (due to depth and/or yield of groundwater), construct the monitoring well using 10 feet of 2-inch diameter Schedule 5 stainless steel wirewound screen (0.010-inch slot or a slot size appropriate to the formation) and 2-inch diameter Schedule 5 stainless steel riser pipe. For non-flush mounted wells, at least 2 feet of riser pipe must extend above the ground surface. Flush-mounted wells will only be installed in high traffic areas, such as roadways.

- 10. Backfill the annular space to approximately 2 feet above the well screen with a sand filter pack. The filter pack shall be Morie No. 1 graded sand or a filter pack appropriate to the formation. The remaining annular space will be filled with bentonite/cement slurry to the surface. The ratio of cement to bentonite for grouting will be approximately 94 pounds of cement to every 5 pounds of bentonite as per NJDEP well installation procedures.
- 11. Complete the constructed monitoring well as described in Procedure #12D.

Rock Coring (Procedure #12B)

- 1. Conduct NQ (wireline) bedrock coring using a standard core barrel, 10 feet in length.
- 2. Instruct the drilling subcontractor personnel to place the recovered 2-inch rock core in a preconstructed wooden rock core storage box upon retrieval of the core barrel.
- 3. Photograph each core box with the core run identification clearly indicated.
- 4. Record the following observations of the coring process and the recovered rock core in the field logbook:
 - The depth at which hole diameters (bit sizes) change;
 - The coring run length;
 - The total recovery (the recovered core length divided by the total run length expressed in percentage);
 - A description of the rock, including lithology and texture, color, hardness, weathering, structural discontinuities, and local geologic names;
 - Information on fracture frequency, fracture fit, fracture spacing, fracture orientation, and odors/discoloration; and
 - The Rock Quality Designation (RQD) value (the sum of all unbroken sections of core greater than or equal to 4 inches in length divided by the total run length, expressed in percentage).

Piezometer Wells (Procedure #12C)

1. Advance each borehole to the pre-determined depth (which will be outlined in the Pumping Test Plan) utilizing 6 1/4-inch ID hollow-stem augers. If it is determined in the Pumping Test Plan to be advantageous, subsurface soil samples will be collected during borehole advancement with carbon steel split-spoon samplers in accordance with Procedure #9 and ASTM Method D-1586-84.

- 2. Construct piezometer well using 2-inch diameter Schedule 40 PVC screen (0.010-inch slot or slot size appropriate to the formation) and 2-inch diameter Schedule 40 PVC.
- 3. Backfill the annular space to approximately 2 feet above the well screen with a sand filter pack of Morie No. 1 graded sand (or appropriate to the formation). The remaining annular space will be filled with bentonite/cement slurry (94 pounds of cement to every 5 pounds of bentonite) to the surface.
- 4. Complete the piezometer using the bentonite/cement slurry around the casing.

Following successful completion of the aquifer pumping test, piezometer wells will be removed.

Monitoring Well Completion (Procedure #12D)

Each monitoring well installed at the Cornell-Dubilier Site as part of the field investigation will be completed in accordance with the following procedure:

- 1. Install a locking steel cap over the top of the carbon steel casing. The cap will be locked to ensure that well access will only be provided during well development, sampling or water level measurement events. All locks will be keyed alike. The monitoring well ID number will be stamped on the protective casing with a steel die, and the well casing coated with a protective paint. A protective casing will be used for overburden wells.
- 2. Construct a concrete pad around the security casing mounded in such a way as to direct surface runoff from the casing. Concrete will be used to fill the space above the bentonite-cement slurry (at approximately 3-feet below grade) to grade, including a 2-foot by 2-foot by 8-inch pad in accordance with NJDEP well installation procedures. Drill a hole in the protective casing above the concrete pad to provide a drain for water accumulated within the casing annulus.

Monitoring Well Development (Procedure #12E)

Each monitoring well installed at the Site as part of the field investigation will be developed in accordance with the following procedure:

1. Wait at least 48 hours for the grout to cure subsequent to monitoring well completion before beginning well development. Each new well will be developed by pumping and surging. The surge blocks will be cylinders that have a diameter slightly smaller than the borehole of the well. Rubber flaps of a slightly larger diameter will be attached to the surge blocks and will come into contact with the sides of the borehole. The surge blocks will be raised and lowered across the length of the screen to remove fine particles and deposits which may be clogging the screen. During the surging procedure the well be pumped using a centrifugal pump to remove suspended particles and induce flow into the well to prevent clogging of the sand pack.

2. Continue development until there is less than a 10 percent variance between successive measurements of pH, temperature, turbidity, and conductivity and/or turbidity is less than 5 NTUs. Development will be continued for a minimum of two hours, but for no longer than eight hours without USEPA permission.

Development (and purge water) will be containerized in drums and/or an on-site frac tank for proper disposal.

3.3.15 <u>Drainage System Sampling</u>

During the Reconnaissance Phase of the field investigation, the location and discharge point of the on-site drains, manholes, catch basins, etc. will be determined (see Section 3.3.5). In addition, the presence of standing water and/or sediment within these drains, manholes, catch basins, etc. will be noted. Samples of the standing water and sediment will be collected during the Phase I Investigation from an estimated 5 locations in and around the on-site buildings; however, the number of standing water and/or sediment samples may be modified based on the results of the reconnaissance determination and dye testing.

The standing water and sediment drainage system samples will be collected as follows (Procedure #13):

- 1. Use one of the following pieces of equipment to collect standing water samples:
 - A Teflon/stainless steel scoop with a Teflon/stainless steel handle
 - A stainless steel beaker clamped to a pole
 - Sample bottles (direct fill)
- 2. Submerge the bottle, beaker or scoop and collect a sample. Care should be exercised when pouring the water into the sample bottles from a beaker or scoop so as not to aerate the sample.
- 3. Preserve the sample containers as follows:
 - VOCs Determine the volume of 1:1 HCl preservative required to adjust the pH of the sample to less than 2 on an extra 40 ml glass vial prior to sampling. Prepreserve sample bottles with the determined volume of HCl (if possible) and fill with sample. Check the bottle for the presence of trapped air by tapping the bottle when filled and capped.
 - Other Parameters Add appropriate volume of preservative (as specified in the QAPP) to the sample bottle. Verity pH by pouring a minimal portion of the sample onto broad range pH paper.
- 4. After collection of standing water sample, collect a sample of the sediment withing the manhole, catch basin, etc.

- 5. If the depth of the manhole, basin, etc. permits, directly collect TCL VOC sample utilizing Steps 4 through 14 of Procedure #8. If the depth of the manhole, basin, etc. does not permit direct collection for the VOC sample, obtain sediment sample following Step 6 below and then insert the core sampler into sediment in the sampling device.
- 6. Use a decontaminated stainless steel shovel, trowel or remote sampling device (depending on depth) to obtain sediment. Empty contents of device into a decontaminated stainless steel bowl or pan. Repeat until enough sample is collected to fill all other required containers.
- 7. Homogenize sediment within bowl/pan with decontaminated stainless steel spoon or trowel. Fill sample containers for TCL SVOC, TCL pesticide/PCB, and TAL metal and cyanide analyses.
- 8. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 9. Place the analytical samples in a cooler for shipment and chill to 4°C.

3.3.16 Building Interior Sampling [Air]

Building air sampling will be performed in the 24 on-site buildings during Phase II.

The following procedure will be used for air sampling of VOCs, and is based on USEPA ERT SOP #1704 (Procedure #14A):

- I. Subatmospheric Pressure Sampling Using a Fixed Orifice, Capillary, or Adjustable Micrometering Valve
 - 1. Complete the appropriate information on the Canister Sampling Data Field Sheet.
 - 2. A canister, which is evacuated to 0.05 mm Hg and fitted with a flow restricting device, is opened to the atmosphere which contains the VOCs for sampling. The pressure differential causes the sample to flow into the canister.
 - 3. This technique can be used to collect grab samples having a duration of 10 to 30 seconds or time-integrated samples having a duration of 12 to 24 hours. The sampling duration is depends on the degree to which the flow is restricted.
 - 4. As the pressure approaches atmospheric pressure, a critical orifice flow regulator will cause a decrease in the flow rate.
 - 5. Record data on an appropriate data sheet and/or in the field logbook.

- ii. Subatmospheric Pressure Sampling or Pressurized Sampling Using a Mass Flow Controller/Vacuum Pump Arrangement (Andersen Sampler Model 87-100)
 - 1. Complete the appropriate information on the Canister Sampling Data Field Sheet.
 - 2. Open a canister, which is evacuated to 0.05 mm Hg and connected in line with the sampler, to the atmosphere which contains the VOCs for sampling.
 - 3. A whole air sample will be drawn into the system through a stainless steel inlet tube by a direct drive blower motor assembly. A small portion of this whole air sample is drawn from the inlet tube by a specially modified inert vacuum pump in conjunction with a mass flow controller.
 - 4. The initially evacuated canister is filled by the action of the flow controlled pump to near atmospheric pressure (subatmosphereic pressure sampling) or a positive pressure not to exceed 25 psig (pressurized sampling).
 - 5. A digital time program is used to pre-select sample duration and start and stop times.
 - 6. Record data on an appropriate data sheet and/or in the field logbook.

The following procedure will be used for air sampling of SVOCs and/or pesticides/PCBs, and is based on USEPA ERT SOP #2121 (Procedure #14B):

- 1. Using a calibrated sampler, place the sampler in the desired location. The polyurethane foam (PUF) sampler should be in the breathing zone in order to prevent elevated results. It should be located in an unobstructed area, at a distance of twice the height of any obstruction to air flow but no closer than two meters to the obstacle.
- 2. Assemble the sampling system by attaching the legs and magnehelic panel to the platform. Connect the motor to the platform, making sure that the gasket is placed between the motor and the platform. Plug the motor into the timer located on the magnehelic panel. Connect the magnehelic to the venturi with tubing. Adjust the exhaust hose to face downwind of the sampler.
- 3. Put on clean surgical gloves.
- 4. Place the loaded sampling module into the quick release fitting and engage by locking the two levers down securely. Remove the metal cover.
- 5. Record the pump number, location, sample start time, time/counter at the start, and other pertinent information on an appropriate data sheet and/or in the field logbook.
- 6. Plug in the unit. If necessary, adjust the magnehelic gauge by turning the ball valve in order to achieve the reading required to reach the target flow rate. Wait approximately two minutes for the magnehelic reading to stabilize.

7. Allow the sampling system to operate for the predetermined duration. If the sampling system is in use for more than 24 hours, the initial calibration should be audited every 24 hours. If the resultant value for the check is +/- 7 percent of the initial calibration, the sampling system must be recalibrated.

The following procedure will be used for air sampling of metals, and is based on USEPA ERT SOP #2119 (Procedure #14C):

- 1. Assemble the sampling trains with clean filter cassettes. Verify the pump calibration by removing the inlet plug from the cassette, attaching a rotameter with Tygon tubing and turning on the sampling pump. Check to make sure all the connections are tight.
- 2. Record the actual flow rate on an appropriate data sheet and/or in the field logbook. Replace the inlet plug until ready to sample.
- 3. Set the sampling pump timer (low volume pumps) for the predetermined sampling time, or record the elapsed timer on the data sheet/logbook. This will be determined based on the type of pump being used.
- 4. Deploy sampling pumps at sampling locations. Remove the cassette cap or inlet plug from the cassette. Sampling for elements can be conducted with the cassettes open-faced (cassette cap removed) or closed-faced (only inlet port plug removed). Open-faced is preferred because it allows even loading of the filter cassette and should be used whenever high particulate concentrations are expected in order to allow greater particulate loading of the filter. Closed-faced sampling is performed when there is a possibility that the sample may be shaken and particulates may be lost.
- 5. Turn on the sampling pump and let it run for the predetermined sampling period.
- 6. After the sampling period is over, verify the sampling period by reading the sample run time (low volume pumps) or by checking the elapsed time on the counter (medium volume pumps). Record the length of sampling time on the data sheet and/or in the field logbook. Turn off the pump.
- 7. Verify the pump calibration by attaching a rotameter with Tygon tubing and turning on the sampling pump. Record the actual flow rate. Insert the inlet plug.
- 8. Remove the sampling cassette from the sampling train and insert the outlet plug. Calculate sample volume.

The following procedure will be used for air sampling of asbestos, and is based on USEPA ERT SOP #2015 (Procedure #14D):

1. Before starting the sampling pumps, direct forced air (such as a 1-horsepower leaf blower or large fans) against walls, ceilings, floors, ledges, and other surfaces in the room to

- initially dislodge fibers from surfaces. This should take at least five minutes per 1,000 ft² of floor.
- 2. Place a 20-inch fan in the center of the room (one fan per 10,000 ft³ of room space) and place it on slow speed directed towards the ceiling.
- 3. Set up the sampling train by attaching the air intake hose to the cassette base and remove the cassette cap. The cassette should be positioned downward, perpendicular to the wind.
- 4. Turn on the AC/DC electricity or position the generator 10 feet downwind from the sampling pump.
- 5. Record the date, time, location, sample identification number, pump number, flow rate, cumulative time, and other pertinent information on an appropriate data sheet and/or in the field logbook.
- 6. Turn the pump on. Should intermittent sampling be required, sampling filters <u>must</u> be covered between active periods of sampling. Check the pump at the midpoint of sampling, if the sampling lasts longer than 4 hours. If a filter darkens or loose dust is seen in the filter, start a second sample.
- 7. At the end of sampling, orient the cassette up and turn off the pump. Turn off the fans. Check and record the flow rate, and the cumulative time or run.
- 8. Remove the tubing from the sampling cassette. Still holding the cassette upright, replace the inlet plug on the cassette cap and the outlet plug on the cassette base. Wrap cassettes individually in plastic sample bags.

3.3.17 Ecological Resources Reconnaissance

During the Reconnaissance Phase, an ecological resources reconnaissance of the Site will be performed by Foster Wheeler Environmental in support of the ecological setting characterization required for the ecological risk assessment for the site. The ecological site reconnaissance will consist of qualitative descriptions of on-site vegetation cover types, direct/indirect observations of wildlife or wildlife activity, and observations of areas of stained soils/stressed vegetation (if present). The ecological reconnaissance data will be used to identify the presence of ecological receptors, document potential exposure pathways by which ecological receptors may be exposed to on-site soil contaminants, and identify potential areas for use as additional surface soil sampling points.

3.3.18 Sediment Sampling

Sediment sampling, if performed during the Phase II Investigation, will be conducted concurrently with surface water sampling. Surface sediments (0 to 6 inches bgs, with 6 to 12 inches bgs for VOCs) will be collected using a stainless steel shovel or trowel, or remote sampling device in shallow water locations, and using a ponar grab or equivalent in deeper water locations. Sediment

samples will be obtained following the collection of surface water samples at each location, and will be collected moving in an upstream direction The sediments will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals and cyanide, TOC, and grain size, and/or undergo toxicity and bioassay testing.

Shallow Water Sediment Sampling (Procedure #15A)

- 1. After collection of surface water samples at a location, use a decontaminated stainless steel shovel or trowel to scrape away surficial organic material (grass, leaves, etc.).
- 2. Obtain sediment using a grab sampler or corer from the surface to 6 inches bgs. Fill sample container for other volatile (e.g., TOC) parameters as discrete grab samples. Then, empty remaining contents of shovel/trowel into a decontaminated stainless steel bowl or pan. Repeat until enough sample is collected to fill all other required containers. Obtain sediment for toxicity and bioassay testing following Procedure #15C, as necessary.
- 3. Obtain VOC sample utilizing Steps 4 through 14 of Procedure #8, from 6 to 12 inches bgs.
- 4. Homogenize sediment within bowl/pan with decontaminated stainless steel trowel or spoon. Remove rocks, twigs, leaves and other large debris as appropriate. Fill sample containers for remaining chemical parameters.
- 5. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 6. Place the analytical samples in coolers for shipment and chill to 4°C.

Deeper Water Sediment Sampling (Procedure #15B)

- 1. After collection of surface water samples at a location, obtain a sediment sample using a decontaminated ponar dredge or equivalent sampler.
- 2. Arrange the ponar dredge sampler in the open position, setting the trip bar such that the sampler remains open when lifted from the top.
- 3. Connect a sturdy nylon rope or steel cable to the hook provided on the top of the sampler.
- 4. Lower the dredge through the water to the sediment layer. The descent speed should be fairly rapid but controlled; if the sampler is allowed to free fall, the device may land improperly or cause pressure to blow the surface layer of sediments away on impact.
- 5. When the sampler reaches the bottom, tug on the line to release the trigger bar and capture the sample.
- 6. Pull the dredge to the surface, and decant any free liquid through the screens at the top of the sampler device.

- 7. Obtain VOC sample utilizing Steps 4 through 14 of Procedure #8 but inserting core sampler into sediment in sampler device. Fill sample container for other volatile (e.g., TOC) parameters as discrete grab samples. Empty remaining contents of shovel/trowel into a decontaminated stainless steel bowl or bucket.
- 8. Repeat Steps 2 through 7, until enough sample is collected to fill all other required containers. Obtain sediment for toxicity and bioassay testing following Procedure #15C, as necessary.
- 9. Homogenize sediment within bowl/bucket with decontaminated stainless steel trowel or spoon. Remove rocks, twigs, leaves and other large debris as appropriate. Fill sample containers for remaining chemical parameters.
- 10. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 11. Place the analytical samples in coolers for shipment and chill to 4°C.

Collection of Bulk Sediment Samples for Sediment Toxicity Tests and Bioassays (Procedure #15C)

The samples to be collected using this procedure are large-volume sediment samples that will be used for sediment toxicity tests and in bioassay tests (as necessary).

The equipment required is as follows:

- A decontaminated sampling device
- 1 to 3 gallon polyethylene buckets with tight-fitting lids
- A decontaminated stainless steel rod for stirring
- 1. Using the sampling device, obtain sediment to a depth of approximately 6 inches. The top layer of sediment (0 to 6 inches bgs) is of most interest. Sampling is therefore to be restricted as much as possible to this interval of sediment. Begin downstream and work towards the upstream direction.
- 2. Place the sediment in the polyethylene bucket.
- 3. Repeat Steps 1 and 2 until the bucket is approximately 90 percent full.
- 4. When the bucket is about 90 percent full, use the stainless steel rod to stir the sediment in order to homogenize the sediment. Decant any excess water from the top of the bucket.
- 5. Transfer an aliquot of the homogenized sediment to a soil sampling container and prepare to ship for laboratory analysis.
- 6. Cover the sediment remaining in the bucket with plastic wrap to help preserve moisture retention, and place the lid securely on the bucket.

7. Complete sample labels, custody seals, and chain of custody forms. Record sample information in the field notebook. The sample bucket must be stored in a cool, dark place until shipped. Samples for bioassays are not to be collected until all arrangements for laboratory work have been made, because of the 14-day holding period.

3.3.19 Surface Water Sampling

During the Phase II Investigation, surface water samples may be collected at locations within Bound Brook, New Market Pond, and\or Spring Lake. Samples may be collected at depth within New Market Pond and Spring Lake, depending on analytical requirements. Field measurements to be collected during sampling will include temperature, dissolved oxygen, conductivity, turbidity, and pH. Surface water samples shall be collected moving in an upstream direction.

Shallow Surface Water Sampling (Procedure #16A)

- 1. Any of the following equipment may be used to collect samples:
 - A Teflon/stainless steel scoop with a Teflon/stainless steel handle
 - A stainless steel beaker clamped to a pole
 - Sample bottles (direct fill)
- 2. Measure and record temperature, dissolved oxygen, pH and specific conductance using a Horiba® water quality meter or equivalent and following the procedures in Procedure #19C.
- 3. Submerge the bottle, beaker or scoop and collect a sample. When pouring the water from a beaker or scoop into another bottle container, care should be exercised so as not to aerate the sample. VOC samples will be collected first.
- 4. Preserve containers as follows:
 - VOCs Determine the volume of 1:1 HCl preservative required to adjust the pH of the sample to less than 2 on an extra 40 ml glass vial prior to sampling. Prepreserve sample bottles with the determined volume of HCl (if possible) and fill with sample. Check the bottle for the presence of trapped air by tapping the bottle when filled and capped.
 - Other Parameters Add appropriate volume of preservative (as specified in the QAPP) to sample bottle. Verify pH by pouring a minimal portion of the sample onto broad range pH paper.
- 5. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 6. Place the analytical samples in a cooler for shipment and chill to 4°C.

Sampling the Water Column at Depth in Lentic Environments (Procedure #16B)

This procedure is applicable to sampling in the New Market Pond and Spring Lake water column.

- 1. Measure water depth at the proposed sampling station.
- 2. Collect water samples using a Van Dorn or Kemmerer sampler or equivalent. The sampler will be lowered from the boat with a stainless steel Teflon-coated wire that has been marked off at one foot intervals.
- 3. Lower (with the sampling device) an automated pH, temperature, dissolved oxygen, turbidity, and specific conductivity reading instrument (Horiba® or equivalent); see Procedure #19C.
- 4. Samples shall be collected prior to sediment samples by submerging the sampler to the desired depth (within one foot of the bottom substrate).
- 5. Collect water sample remotely and retrieve sample.
- 6. Aliquot adequate volumes to individual bottleware for the selected analyses, collecting VOC sample first, and preserve as per Step 4 of Procedure #16A.
- 7. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 8. Place the analytical samples in a cooler for shipment and chill to 4°C.

3.3.20 Biota Sampling

Biota samples (plant, invertebrate, fish, and/or small mammal samples) may be collected from around the Site; within/along Bound Brook, New Market Pond, and Spring Lake; and from appropriate reference stations for evaluation of impacts, during the Phase II Investigation. The numbers and species of biota sampled will be based on the Screening Level Ecological Risk Assessment (SLERA) results. Biota samples would be analyzed for selected contaminants based upon the SLERA results.

Plant Sampling (Procedure #17A)

Plant samples would be collected by the following procedure:

- 1. Search for occurrence of flora in the vicinity of the sample locations.
- 2. Based upon environmental characteristics of known Site contaminants, select plant tissues (i.e., roots, stems, leaves, etc.) of a single species or multiple species.

- 3. Select plants of same or similar species and similar size at the sample locations and reference location.
- 4. Collect sufficient quantity of plant tissue for analytical requirements.
- 5. Record species collected and numerical quantity by sample.
- 6. Wrap sample in aluminum foil (shiny side out). Weigh composited sample mass. Place sample in plastic bag and freeze with dry ice to preserve sample.
- 7. Collect replicates at each sampling location (as necessary) following Steps 1 through 6.
- 8. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 9. Analyze for selected contaminants based upon SLERA results.

Soil Invertebrate Sampling (Procedure #17B)

Soil invertebrate samples would be collected by the following procedure:

- 1. Search detritus and debris for occurrence of soil invertebrates in the vicinity of the corresponding ecological surface soil sample locations.
- 2. Select invertebrates of the same species at the sample locations and reference location.
- 3. Based upon abundance and spatial occurrence, collect sufficient quantity for analytical requirements.
- 4. Record species collected and numerical quantity by sample.
- 5. Wrap sample in aluminum foil (shiny side out). Record weight of final composited sample mass. Place sample in plastic bag and freeze with dry ice to dispatch invertebrates and preserve sample.
- 6. Collect replicates at each sampling location (as necessary) following Steps 1 through 5.
- 7. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 8. Analyze for selected contaminants based upon SLERA results and percent lipids.

Fish Sampling (Procedure #17C)

Fish sampling would be conducted utilizing seine nets, as stated below:

- 1. After removal of tangles and twists, place a 50-foot length of seine netting in the water. Local stream/lake morphology may dictate the use of a shorter length, and the Site Ecologist will determine the proper length of seine to employ.
- 2. Anchor one end of the seine close to the shoreline.
- 3. Deploy the seine net out into the water body at approximately a 45 degree angle. If sampling is being performed on a stream, the net should be angled out on the downstream side.
- 4. Sweep the seine toward the shore.
- 5. Carefully remove all fish species, and place in a polyethylene or stainless steel bucket. Do not allow specimens to dry out.
- 6. Repeat Steps 2 through 5 until a sufficient number of fish is collected, as ascertained by the Site Ecologist.
- 7. Select fish of the same species, sex and age at the sample locations and reference location.
- 8. Whole carcasses or, as necessary, appropriate organs and tissues (i.e., liver, carcass) should be removed, placed on aluminum foil, weighed, wrapped in the foil (shiny side out), placed in sampling jars or plastic bags, and frozen in the field using dry ice. Samples must be shipped to the laboratory within 24 hours.
- 9. Collect replicates at each sampling location (as necessary) following Steps 1 through 8.
- 10. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 11. Analyze sample for selected contaminants based upon SLERA results and percent lipids.

Small Mammal Sampling (Procedure #17D)

Small mammals such as mice can be sampled utilizing live-traps such as the Sherman and Havahart box traps, and pitfall traps, or using kill-traps such as the Museum Special snap trap or a combination of trap types. Use of box-type live-traps is usually preferred; however, trap-type selection should be made based on the population being studied, specific data objectives, and site-specific conditions.

The following is an outline of the trapping approach methodology:

- 1. Set out traps in a grid pattern or along line transects. Each sampling station represents a point within the grid or along a transect. (Note: pitfall traps are usually set using drift fences).
- 2. Bait the traps using small amounts of a mixture of peanut butter and rolled oats. (Note: pitfall traps do not require baiting).
- 3. Check traps twice daily, in the early morning and just before dark. At this time, reset any sprung traps.
- 4. Captured animals should be identified, weighted, measured, and sexed (if possible). If live-traps are used, and a mark-recapture study is desired, animals should also be marked (usually by toe-clip) and then released.
- 5. Select mammals of the same species at the sample locations and reference location.
- 6. Place sample on aluminum foil, and weigh. Wrap the sample in the foil (shiny side out), and then place in sampling jars or plastic bags, and freeze in the field using dry ice. Samples must be shipped to the laboratory within 24 hours.
- 7. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
- 8. Analyze sample for selected contaminants based upon SLERA results and percent lipids.

3.3.21 Water Level Measurement

Static water level measurements will be taken in all installed monitoring wells and piezometers (as applicable) prior to each round of groundwater sampling. A corresponding surface water elevation measurement will also be conducted prior to each groundwater sampling round. These measurements will also be acquired in selected monitoring wells/piezometers during the aquifer pumping test to be performed during the Phase II Investigation (see Section 3.3.23). Additional rounds of measurements may be collected throughout the field activities under the direction of the FOL or Site Geologist.

Water level measurements will be conducted in accordance with the following procedure (Procedure #18):

1. Groundwater level measurements will be collected from all monitoring wells primarily using an electronic water level indicator. An interface probe will also be used during the initial measurement round and periodically through the program to check for the presence of free product. Water levels will be measured, relative to surveyed datum (i.e., top of well riser), at a specific mark on the casing, to the nearest 0.01 foot.

- 2. Electronic water level indicators will preferably be the type with water level markings on the cable at increments of 0.01 foot or less.
- 3. All electronic water level measurements will be recorded in the appropriate field logbook or data sheet.
- 4. The electronics of a water level indicator will be checked prior to the commencement of measurements with a jar of water and the depths calibrated on the ground against a steel tape.
- 5. Surface water elevations will be visually read directly from the installed stream gauge and will be recorded to the nearest 0.01 foot in the appropriate field logbook.

3.3.22 Groundwater Sampling

Groundwater samples will be collected from all monitoring wells installed at the Cornell-Dubilier Site. One round of groundwater samples will be collected from the 11 installed monitoring wells during the Phase I Investigation (denoted Round I). Additional groundwater sampling rounds will be performed during the Phase II Investigation, as required. Groundwater samples will be obtained starting at the least contaminated well and proceeding systematically to the well likely to be most contaminated. Collection will proceed via the low flow purge method in accordance with USEPA Region II procedures (Attachment D). All monitoring well samples will be analyzed for low concentration VOCs, low concentration SVOCs, low concentration pesticides/PCBs, TAL metals and cyanide, haloacetic acids, and water quality parameters (total organic carbon, dissolved organic carbon, total suspended solids, total dissolved solids, ammonia, nitrate-nitrite, total phosphorus, hardness, chloride, chlorite, and bromate). In addition, groundwater samples from wells MW04, MW06 and MW09 will be analyzed for PCB congeners.

The presence of free product will be investigated during the first groundwater sampling round of each investigation phase. An interface probe will be dropped through the water column in each monitoring well to check for the presence of non-aqueous phase liquids (NAPLs) prior to purging. If significant quantities of either light or dense NAPLs (LNAPLs or DNAPLs) are encountered in any monitoring well, a clear dual-valve Teflon bailer will be inserted into the well. The product thickness indicated using the interface probe will be verified with the thickness observed within the bailer. A sample of the NAPL should be collected, and then the pump installed in the well. However, if DNAPL is present, the groundwater in the monitoring well should not be sampled immediately; as per USEPA procedures, the well (with the pump installed) must sit for several days prior to sampling. No NAPL samples are estimated to be collected during the Phase I Investigation.

NAPL Sampling Procedure (Procedure #19A)

- 1. Check and record the condition of the well for any damage or evidence of tampering.
- 2. Remove the well cap.
- 3. Measure well headspace with a PID or FID and record the reading in the field logbook.

- 4. Measure NAPL thickness using an oil/water interface probe. Record the NAPL depth and water depth in the logbook.
- 5. Collect the NAPL sample by slowly lowering a double-check valve bailer into the well in a controlled manner (i.e., with minimal disturbance) to the appropriate depth (LNAPLs at surface interface, DNAPLs to depth of well). After collecting the sample, carefully lift the bailer and pour the liquid into the sample container.
- 6. Record a description of the product and the procedures in the logbook.
- 7. Complete sample log, labels, custody seals and chain of custody forms. Record in field notebook. Place analytical samples in a cooler for shipment and chill to 4°C.

Low Flow Purge Procedure (Procedure #19B)

- 1. Check and record the condition of the well for any damage or evidence of tampering.
- 2. Remove the well cap.
- 3. Measure well headspace with a PID or FID and record the reading in the field logbook.
- 4. Measure and record the depth to water as stated in Procedure #18 and record the measurement in the field logbook. Do not measure the depth to the bottom of the well at this time (to avoid disturbing any sediment that may have accumulated). Obtain depth to bottom information from installation information in the field logbook or drilling logs. Calculate volume of the water column as shown in Figure 5-8 of the QAPP (Part C).
- 5. Lay out plastic sheeting and place the monitoring, purging and sampling equipment on the sheeting. To avoid cross-contamination, do not let any downhole equipment touch the ground.
- 6. Re-check and record the depth to water after approximately 5 minutes at the well location. If the measurement has changed more than 0.01 foot, check and record the measurement again, then begin well purging.
- 7. Attach and secure the Teflon-lined polyethylene tubing to the low-flow submersible pump. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties placed approximately 5 feet apart.
- 8. Set the pump at approximately the middle of the screen and/or the best depth based on the stratigraphy of the well. Be careful not to place the pump intake less than 2 feet above the bottom of the well as this may cause mobilization of any sediment present in the bottom of the well. Start pumping the well at 0.2 to 0.5 liters per minute.
- 9. Monitor the water level in the well periodically during pumping, and ideally the pump rate should equal the well recharge rate with little or no water level drawdown in the well

(drawdown shall be 0.3 foot or less). There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrapment of air in the sample. Record the pumping rate adjustments and depth(s) to water in the logbook. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (0.1 to 0.2 liters per minute) to avoid purging the well dry. However, if the recharge rate of the well is very low and the well is purged dry, then wait until the well has recharged to a sufficient level and collect the appropriate volume of sample with the submersible pump.

- 10. Purge the well at a low-flow rate (from 0.2 to 0.5 liters per minute). During purging, monitor the field parameters (temperature, pH, turbidity, Eh, specific conductance, and dissolved oxygen) approximately every 3 to 5 minutes. A flow-through cell will be used to monitor the field parameters (see Procedure #19C). Begin measuring field parameters after the flow-through cell has been "flushed" with groundwater twice.
- 11. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings, as follows:
 - 0.1 for pH
 - 3 percent for specific conductance
 - 10 percent for dissolved oxygen
 - 10 percent for turbidity
 - 10 mV for Eh

Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

- 12. Once the field parameters have stabilized, collect the samples directly from the end of the tubing. Volatiles and analyses that degrade by aeration must be collected first. The bottles should be preserved and filled according to the procedures specified below and in the QAPP.
- 13. Fill all sample bottles by allowing the pump discharge to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled.
- 14. Preserve and label the samples, and record them on the chain of custody. Place immediately into a cooler for shipment and maintain at 4°C.
- 15. The filling and preservation procedures will be:
 - VOAs Determine the amount of 1:1 HCl preservative required to adjust the pH of the sample to less than 2 in an extra 40 ml glass vial. Add this volume to the empty 40 ml vials prior to sampling. Fill each container with sample to just overflowing so that no air bubbles are entrapped inside. If effervescence occurs, submit the sample without preservative and note on the chain of custody form.

- Other Parameters Fill each container and preserve immediately as required. To test for pH, pour a minimal portion of sample onto broad range pH paper to verify that the appropriate pH level has been obtained.
- 16. Carefully remove the pump assembly from the well. The Teflon-lined polyethylene tubing will be dedicated to each well. The tubing should be placed in a large plastic garbage bag, sealed, and labeled with the appropriate well identification number.
- 17. After sampling is complete, measure the total depth of the well.
- 18. Close and lock the well.

Field Parameter Measurement (Procedure #19C)

Field parameters (temperature, pH, turbidity, Eh, specific conductance, and/or dissolved oxygen) will be monitored during purging of the monitoring wells and prior to surface water sampling, utilizing a Horiba® water quality meter or equivalent. Measurements will be conducted in accordance with the manufacturer's instructions and the following procedure:

- 1. Calibrate the water quality meter as per manufacturer's instructions.
- 2. For low flow purging of the monitoring wells:
 - Attach a flow-through cell to the Teflon-lined polyethylene tubing. Position the water quality meter probe in the flow-through cell. Begin purging the monitoring well, following Procedure #19B.
 - After the cell has been "flushed" at least twice, begin monitoring the field parameters, and continue approximately every 3 to 5 minutes during purging. All water quality measurements will be recorded in the appropriate field logbook or on a well purge data sheet.
 - When the indicator parameters have stabilized for three consecutive readings (see Step 11 of Procedure #19B), the well is considered stabilized and ready for sample collection. Remove the flow-through cell from the tubing.
- 3. For surface water sampling, position the probe directly in the water body. All water quality measurements will be recorded in the appropriate field logbook.
- 4. The probe of the water quality meter will be decontaminated between wells by rinsing with deionized water (see Section 3.3.24).

3.3.23 Aquifer Testing

A 72-hour aquifer pumping test will be performed during the Phase II Investigation to provide data on the hydraulic properties of the aquifer(s) beneath the Site. This procedure incorporates guidelines described in ASTM Method D4050-91. Prior to the aquifer test, a technical

memorandum shall be submitted to USEPA which provides details on the selected pumping well, recommended monitoring wells/piezometers for data collection, and anticipated extraction rate.

Step Test(s) (Procedure #20A)

Short term step tests of the selected pumping well (to be determined during the field investigation) will be performed to estimate the hydraulic property of the aquifer(s) and to establish a pumping rate for the long-term test.

The well will be pumped at several successively higher pumping rates, and the drawdown for each step will be recorded. The rates may be increased without recovery periods, or the water level may be allowed to recover to the static level between each step. Each step test will have the same duration. Four to five steps are expected to be performed, each lasting 1 to 2 hours.

Water levels will be measured in all selected observation wells prior to start of pumping to establish the pre-pumping trend (i.e., fluctuations in groundwater levels unrelated to the pump test). The period of monitoring will be nine days. The trend in all observation wells should be similar. A well with an unusual trend may reflect effects of local disturbance in the hydrologic system.

The pumping rate will be selected on the basis of the step test interpretation. The selected rate will be sustainable for the duration of the test. The optimal rate should not result in drawing the water level below the open space of the control well, thereby causing cascading water and entrained air in the well. Under no circumstances should the selected rate result in a level draw-down to the water-entry section of the pump.

72-Hour Constant-Rate Test (Procedure #20B)

A submersible pump capable of withdrawing a predetermined variable rate of water from the well will be used. The pump should be adequately sized for the design pumping rate and for the well diameter. The pump must be equipped with a control mechanism for adjustments in pumping rate.

Water will be withdrawn from the well at a regulated rate throughout the test. The short-term discharge (measured hourly) should not vary more than 10 percent from the mean discharge. Long-term variation of discharge (i.e., from the beginning to end of the test) should be 5 percent or less.

Discharge will be measured frequently (for example, every five minutes in the tests early stages) and if necessary, adjusted. When the discharge becomes stable, the discharge shall be checked at a frequency at least once every two hours.

A totalizing flow meter will be used for measuring discharge flow rate and total amount of water discharged.

Water level measurements will be obtained using manual electronic tape and pressure transducer on selected wells/piezometers near the test well. The wells selected for pressure transducers shall be determined in the aquifer test memorandum. The pressure transducer should be able to measure pressure changes equivalent to the range of expected water level changes. The transducer will be checked in the field by raising and lowering the transducer a measured distance in the well. Also, the transducer readings will be periodically checked with an electronic tape.

Manual water levels collected with an electronic tape in each observation well shall be measured at logarithmic interval of time. Approximately 10 data points throughout each logarithmic interval will be measured. In wells where a transducer is installed, the measurement frequency may be greater. The measurement schedule frequency is approximately as follows:

Manual Frequency	Transducer Frequency	Elapsed Time
30 sec.	10 sec.	3 min.
1 min.	30 sec.	3 to 15 min.
5 min.	1 min.	15 to 60 min.
10 min.	3 min.	1 to 2 hr.
20 min.	5 min.	2 to 3 hr.
1 hr.	20 min.	3 to 15 hr.
5 hr.	1 hour	15 hr.

Preliminary analysis of the aquifer test data using an appropriate method (for example, ASTM Methods D-4105 and D-4106; see Attachment A) will be performed during the test. The test will be continued until the analysis shows adequate test duration. More sophisticated analytical methods will be used in the final interpretation of data and will be presented in the Pumping Test Plan.

The recovery of water levels following the pumping phase should be measured and recorded for a period of time equal to the pumping time (72 hours). The frequency of measuring water levels should be similar to the frequency during the pumping phase.

Effluent from the pumping test will be containerized in drums and/or an on-site frac tank for proper disposal.

3.3.24 Decontamination

As detailed below, all non-disposable equipment involved in field sampling activities will be decontaminated prior to and subsequent to sampling. Equipment leaving the Site will also be decontaminated.

All drilling equipment will be steam cleaned prior to use. Well screens and riser pipe will also be steam cleaned to remove any cutting oils and staged on clean plastic sheeting prior to installation. Pressurized steam will be used to remove all visible excess material from augers, rods, drill bits, the back of the drilling rig, and other parts of the rig which contact augers, rods, and split-spoons.

Steam cleaning will be conducted on a decontamination pad, which will be constructed on-site for the field investigation.

Field instrumentation (such as interface probes, water quality meters, etc.) will be decontaminated between sample locations by rinsing with deionized water. If visible contamination still exists on the equipment after the rinse, an Alconox detergent scrub will be added, and the probe thoroughly rinsed again.

Decontamination of the floor dust sampling apparatus will consist of the following two steps:

- 1. After removal of the sample catch bottle, open the flow control valve to its maximum floor, tip the sampler back (so that the nozzle is at least 5 cm off the floor), and switch the vacuum on. Place a rubber glove-covered hand over the bottom of the cyclone, and alternate opening and closing the cyclone for 10 seconds to free any loose material adhering the walls.
- 2. Move the sampling apparatus to a well-ventilated area free of dust. Remove the cyclone and elbow at the top of the nozzle tubing. Using a 50 cm long by 3 cm diameter brush, clean the nozzle and all related items up to and including the cyclone and catch bottle with methanol.

Decontamination of non-disposable sampling equipment used to collect samples for chemical analyses (i.e., scoops, trowels, bowls, etc.) will be conducted as described below:

- 1. Alconox detergent and potable water scrub
- 2. Potable water rinse.
- 3. 10 percent nitric acid rinse (ultra pure grade) when sampling for inorganics. Carbon steel split-spoons will be rinsed with a 1 percent nitric acid solution to avoid stripping of metals.
- 4. Potable water rinse.
- 5. Methanol rinse followed by a hexane rinse (solvents are pesticide grade or better) for equipment involved in the sampling of organics.
- 6. Air dry.
- 7. Deionized water rinse (volume at least five times amount of solvent used in rinse step above).
- 8. Air dry.
- 9. Wrap or cover exposed ends of equipment with aluminum foil for transport and handling.

The following decontamination procedures will be performed for the low flow purge and sampling procedures as specified by the current version of the USEPA Region II Low Stress Groundwater Sampling Procedure (Attachment D).

Non-disposable sampling equipment, including the pump, support cable and electrical wires in contact with the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). For pumps, it is strongly recommended that non-disposable sampling equipment, including the pump, support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

USEPA's field experience indicates that the life of pumps may be extended by removing entrained grit. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see below).

Daily Decon

- 1. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- 2. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.
- 3. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- 4. Disassemble pump.
- 5. Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.
- 6. Rinse pump parts with potable water.
- 7. Rinse the pump parts with distilled/deionized water.
- 8. Place impeller assembly in a large glass beaker and rinse with 1 percent nitric acid (HNO₃).
- 9. Rinse impeller assembly with potable water.
- 10. Place impeller assembly in a large glass beaker and rinse with isopropanol.
- 11. Rinse impeller assembly with distilled/deionized water.

Between-Well Decon

- 1. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- 2. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.
- 3. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

4. Final Rinse: Operate pump in a deep basin containing 1 to 2 gallons of distilled/deionized water, as final rinse.

Decontamination of sampling equipment will be kept to a minimum in the field and wherever possible, dedicated disposable sampling equipment will be used. Decontamination fluids and drill cuttings will be stored in U.S. Department of Transportation (DOT)-approved 55-gallon drums or in an on-site storage tank (liquids only) until disposal. Personnel directly involved in equipment decontamination will wear appropriate protective clothing, as stated in the EHS Plan (Part D of the FOP).

4.0 REFERENCES

Federal Interagency Committee for Wetland Delineation. 1989. Federal Manual for Identifying and Delineating Jurisdictional Wetlands, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Washington, DC. Cooperative technical publication.

Foster Wheeler Environmental, 2000a. Work Plan for Remedial Investigation/Feasibility Study, Cornell-Dubilier Electronics Superfund Site, South Plainfield, Middlesex County, New Jersey. March 2000.

Foster Wheeler Environmental, 2000b. Site Management Plan for Remedial Investigation/ Feasibility Study, Cornell-Dubilier Electronics Superfund Site, South Plainfield, Middlesex County, New Jersey. March 2000.

Foster Wheeler Environmental, 2000c. Quality Assurance Project Plan for Remedial Investigation/Feasibility Study, Cornell-Dubilier Electronics Superfund Site, South Plainfield, Middlesex County, New Jersey. March 2000.

Foster Wheeler Environmental, 2000d. Environmental Health and Safety Plan for Remedial Investigation/Feasibility Study, Cornell-Dubilier Electronics Superfund Site, South Plainfield, Middlesex County, New Jersey. March 2000.

USEPA, 1992. United States Environmental Protection Agency. "Specification and Guidance for Obtaining Contaminant-Free Sample Containers," December 1992, EPA 540/R-93/051.

USEPA, 1994. United States Environmental Protection Agency. "Guidance for the Data Quality Objective Process." EPA QA/G-4. EPA/600/R-96/055. September 1994.

USEPA, 1998. United States Environmental Protection Agency. "EPA Quality Manual for Environmental Programs." Order 5360. July 1998.

4-1

ATTACHMENT A

ASTM STANDARD METHODS AND PRACTICES



Designation: D 422 - 63 (Reapproved 1998)

AMERICAN SOCIETY FOR TESTING AND MATERIALS 100 Barr Harbor Dr., West Conshohocken, PA 19428 Reorinted from the Annual Book of ASTM Standards. Copyright ASTM

Standard Test Method for Particle-Size Analysis of Soils¹

This standard is issued under the fixed designation D 422; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than 75 μ m (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 μ m is determined by a sedimentation process, using a hydrometer to secure the necessary data (Note 1 and Note 2).

Note 1—Separation may be made on the No. 4 (4.75-mm), No. 40 (425-µm), or No. 200 (75-µm) sieve instead of the No. 10. For whatever sieve used, the size shall be indicated in the report.

Note 2—Two types of dispersion devices are provided: (1) a high-speed mechanical stirrer, and (2) air dispersion. Extensive investigations indicate that air-dispersion devices produce a more positive dispersion of plastic soils below the 20-µm size and appreciably less degradation on all sizes when used with sandy soils. Because of the definite advantages favoring air dispersion, its use is recommended. The results from the two types of devices differ in magnitude, depending upon soil type, leading to marked differences in particle size distribution, especially for sizes finer than 20 µm.

2. Referenced Documents

- 2.1 ASTM Standards:
- D 421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants²
- E 11 Specification for Wire-Cloth Sieves for Testing Purposes³
- E 100 Specification for ASTM Hydrometers⁴

3. Apparatus

- 3.1 Balances—A balance sensitive to 0.01 g for weighing the material passing a No. 10 (2.00-mm) sieve, and a balance sensitive to 0.1 % of the mass of the sample to be weighed for weighing the material retained on a No. 10 sieve.
- 3.2 Stirring Apparatus—Either apparatus A or B may be used.
 - 3.2.1 Apparatus A shall consist of a mechanically operated

stirring device in which a suitably mounted electric motor turns a vertical shaft at a speed of not less than 10 000 rpm without load. The shaft shall be equipped with a replaceable stirring paddle made of metal, plastic, or hard rubber, as shown in Fig. 1. The shaft shall be of such length that the stirring paddle will operate not less than ¾ in. (19.0 mm) nor more than 1½ in. (38.1 mm) above the bottom of the dispersion cup. A special dispersion cup conforming to either of the designs shown in Fig. 2 shall be provided to hold the sample while it is being dispersed.

3.2.2 Apparatus B shall consist of an air-jet dispersion cup⁵ (Note 3) conforming to the general details shown in Fig. 3 (Note 4 and Note 5).

Note 3—The amount of air required by an air-jet dispersion cup is of the order of 2 ft³/min; some small air compressors are not capable of supplying sufficient air to operate a cup.

Note 4—Another air-type dispersion device, known as a dispersion tube, developed by Chu and Davidson at Iowa State College, has been shown to give results equivalent to those secured by the air-jet dispersion cups. When it is used, soaking of the sample can be done in the sedimentation cylinder, thus eliminating the need for transferring the slurry. When the air-dispersion tube is used, it shall be so indicated in the report.

Note 5—Water may condense in air lines when not in use. This water must be removed, either by using a water trap on the air line, or by blowing the water out of the line before using any of the air for dispersion purposes.

- 3.3 Hydrometer—An ASTM hydrometer, graduated to read in either specific gravity of the suspension or grams per litre of suspension, and conforming to the requirements for hydrometers 151H or 152H in Specifications E 100. Dimensions of both hydrometers are the same, the scale being the only item of difference.
- 3.4 Sedimentation Cylinder—A glass cylinder essentially 18 in. (457 mm) in height and $2\frac{1}{2}$ in. (63.5 mm) in diameter, and marked for a volume of 1000 mL. The inside diameter shall be such that the 1000-mL mark is 36 ± 2 cm from the bottom on the inside.
 - 3.5 Thermometer—A thermometer accurate to 1°F (0.5°C).
- 3.6 Sieves—A series of sieves, of square-mesh woven-wire cloth, conforming to the requirements of Specification E 11. A full set of sieves includes the following (Note 6):

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.03 on Texture, Plasticity, and Density Characteristics of Soils.

Current edition approved Nov. 21, 1963. Originally published 1935. Replaces D 422 – 62.

² Annual Book of ASTM Standards, Vol 04.08.

³ Annual Book of ASTM Standards, Vol 14.02.

⁴ Annual Book of ASTM Standards, Vol 14.03.

⁵ Detailed working drawings for this cup are available at a nominal cost from the American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103. Order Adjunct No. 12-404220-00.

4 D 422

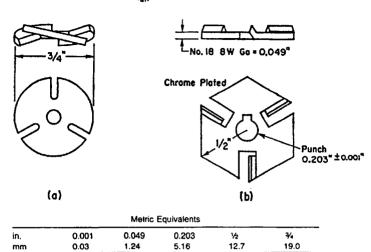
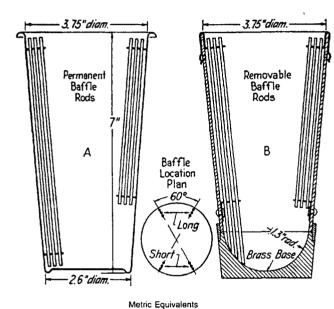


FIG. 1 Detail of Stirring Paddles



in.	1.3	2.6	3.75
mm	33	66	95.2

FIG. 2 Dispersion Cups of Apparatus

3-in. (75-mm)	No. 10 (2,00-mm)
2-in. (50-mm)	No. 20 (850-µm)
1½-in, (37.5-mm)	No. 40 (425-um)
1-in. (25.0-mm)	No. 60 (250-µm)
3/4-in. (19.0-mm)	No. 140 (106-um)
%-in. (9.5-mm)	No. 200 (75-um)
No. 4 (4.75-mm)	,

Note 6-A set of sieves giving uniform spacing of points for the graph, as required in Section 17, may be used if desired. This set consists of the following sieves:

=	
3-in. (75-mm)	No. 16 (1.18-mm
11/2-in. (37.5-mm)	No. 30 (600-µm)
3/4-in. (19.0-mm)	No. 50 (300-µm)
¾a-in. (9.5-mm)	No. 100 (150-µm
No. 4 (4.75-mm)	No. 200 (75-µm)
No. 9 /0.06 mm)	` ' '

3.7 Water Bath or Constant-Temperature Room-A water bath or constant-temperature room for maintaining the soil suspension at a constant temperature during the hydrometer analysis. A satisfactory water tank is an insulated tank that maintains the temperature of the suspension at a convenient constant temperature at or near 68°F (20°C). Such a device is illustrated in Fig. 4. In cases where the work is performed in a room at an automatically controlled constant temperature, the water bath is not necessary.

- 3.8 Beaker—A beaker of 250-mL capacity.
- 3.9 Timing Device—A watch or clock with a second hand.

4. Dispersing Agent

4.1 A solution of sodium hexametaphosphate (sometimes called sodium metaphosphate) shall be used in distilled or demineralized water, at the rate of 40 g of sodium hexametaphosphate/litre of solution (Note 7).

Note 7-Solutions of this salt, if acidic, slowly revert or hydrolyze back to the orthophosphate form with a resultant decrease in dispersive action. Solutions should be prepared frequently (at least once a month) or adjusted to pH of 8 or 9 by means of sodium carbonate. Bottles containing solutions should have the date of preparation marked on them.

4.2 All water used shall be either distilled or demineralized water. The water for a hydrometer test shall be brought to the temperature that is expected to prevail during the hydrometer test. For example, if the sedimentation cylinder is to be placed in the water bath, the distilled or demineralized water to be used shall be brought to the temperature of the controlled water bath; or, if the sedimentation cylinder is used in a room with controlled temperature, the water for the test shall be at the temperature of the room. The basic temperature for the hydrometer test is 68°F (20°C). Small variations of temperature do not introduce differences that are of practical significance and do not prevent the use of corrections derived as prescribed.

5. Test Sample

5.1 Prepare the test sample for mechanical analysis as outlined in Practice D 421. During the preparation procedure

♠ D 422

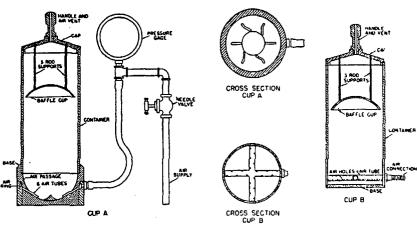


FIG. 3 Air-Jet Dispersion Cups of Apparatus B

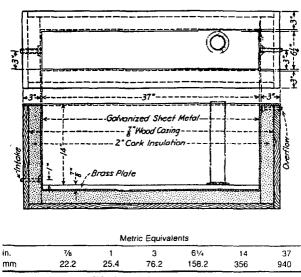


FIG. 4 Insulated Water Bath

the sample is divided into two portions. One portion contains only particles retained on the No. 10 (2.00-mm) sieve while the other portion contains only particles passing the No. 10 sieve. The mass of air-dried soil selected for purpose of tests, as prescribed in Practice D 421, shall be sufficient to yield quantities for mechanical analysis as follows:

5.1.1 The size of the portion retained on the No. 10 sieve shall depend on the maximum size of particle, according to the following schedule:

Nominal Diameter of	Approximate Minimum
Largest Particles,	Mass of Portion, g
in. (mm)	·
% (9.5)	500
₹₄ (19.0)	1000
1 (25.4)	2000
11/2 (38.1)	3000
2 (50.8)	4000
3 (76.2)	5000

5.1.2 The size of the portion passing the No. 10 sieve shall be approximately 115 g for sandy soils and approximately 65 g for silt and clay soils.

5.2 Provision is made in Section 5 of Practice D 421 for weighing of the air-dry soil selected for purpose of tests, the separation of the soil on the No. 10 sieve by dry-sieving and washing, and the weighing of the washed and dried fraction retained on the No. 10 sieve. From these two masses the percentages retained and passing the No. 10 sieve can be calculated in accordance with 12.1.

Note 8—A check on the mass values and the thoroughness of pulverization of the clods may be secured by weighing the portion passing the No. 10 sieve and adding this value to the mass of the washed and oven-dried portion retained on the No. 10 sieve.

SIEVE ANALYSIS OF PORTION RETAINED ON NO. 10 (2.00-mm) SIEVE

6. Procedure

6.1 Separate the portion retained on the No. 10 (2.00-mm) sieve into a series of fractions using the 3-in. (75-mm), 2-in.

3

(II) D 422

(50-mm), 1½-in. (37.5-mm), 1-in. (25.0-mm), ¾-in. (19.0-mm), ¾-in. (9.5-mm), No. 4 (4.75-mm), and No. 10 sieves, or as many as may be needed depending on the sample, or upon the specifications for the material under test.

- 6.2 Conduct the sieving operation by means of a lateral and vertical motion of the sieve, accompanied by a jarring action in order to keep the sample moving continuously over the surface of the sieve. In no case turn or manipulate fragments in the sample through the sieve by hand. Continue sieving until not more than 1 mass % of the residue on a sieve passes that sieve during 1 min of sieving. When mechanical sieving is used, test the thoroughness of sieving by using the hand method of sieving as described above.
- 6.3 Determine the mass of each fraction on a balance conforming to the requirements of 3.1. At the end of weighing, the sum of the masses retained on all the sieves used should equal closely the original mass of the quantity sieved.

HYDROMETER AND SIEVE ANALYSIS OF PORTION PASSING THE NO. 10 (2.00-mm) SIEVE

7. Determination of Composite Correction for Hydrometer Reading

- 7.1 Equations for percentages of soil remaining in suspension, as given in 14.3, are based on the use of distilled or demineralized water. A dispersing agent is used in the water, however, and the specific gravity of the resulting liquid is appreciably greater than that of distilled or demineralized water.
- 7.1.1 Both soil hydrometers are calibrated at 68°F (20°C), and variations in temperature from this standard temperature produce inaccuracies in the actual hydrometer readings. The amount of the inaccuracy increases as the variation from the standard temperature increases.
- 7.1.2 Hydrometers are graduated by the manufacturer to be read at the bottom of the meniscus formed by the liquid on the stem. Since it is not possible to secure readings of soil suspensions at the bottom of the meniscus, readings must be taken at the top and a correction applied.
- 7.1.3 The net amount of the corrections for the three items enumerated is designated as the composite correction, and may be determined experimentally.
- 7.2 For convenience, a graph or table of composite corrections for a series of 1° temperature differences for the range of expected test temperatures may be prepared and used as needed. Measurement of the composite corrections may be made at two temperatures spanning the range of expected test temperatures, and corrections for the intermediate temperatures calculated assuming a straight-line relationship between the two observed values.
- 7.3 Prepare 1000 mL of liquid composed of distilled or demineralized water and dispersing agent in the same proportion as will prevail in the sedimentation (hydrometer) test. Place the liquid in a sedimentation cylinder and the cylinder in the constant-temperature water bath, set for one of the two temperatures to be used. When the temperature of the liquid becomes constant, insert the hydrometer, and, after a short interval to permit the hydrometer to come to the temperature of the liquid, read the hydrometer at the top of the meniscus

formed on the stem. For hydrometer 151H the composite correction is the difference between this reading and one; for hydrometer 152H it is the difference between the reading and zero. Bring the liquid and the hydrometer to the other temperature to be used, and secure the composite correction as before.

8. Hygroscopic Moisture

8.1 When the sample is weighed for the hydrometer test, weigh out an auxiliary portion of from 10 to 15 g in a small metal or glass container, dry the sample to a constant mass in an oven at 230 \pm 9°F (110 \pm 5°C), and weigh again. Record the masses.

9. Dispersion of Soil Sample

- 9.1 When the soil is mostly of the clay and silt sizes, weigh out a sample of air-dry soil of approximately 50 g. When the soil is mostly sand the sample should be approximately 100 g.
- 9.2 Place the sample in the 250-mL beaker and cover with 125 mL of sodium hexametaphosphate solution (40 g/L). Stir until the soil is thoroughly wetted. Allow to soak for at least 16 h.
- 9.3 At the end of the soaking period, disperse the sample further, using either stirring apparatus A or B. If stirring apparatus A is used, transfer the soil-water slurry from the beaker into the special dispersion cup shown in Fig. 2, washing any residue from the beaker into the cup with distilled or demineralized water (Note 9). Add distilled or demineralized water, if necessary, so that the cup is more than half full. Stir for a period of 1 min.

NOTE 9—A large size syringe is a convenient device for handling the water in the washing operation. Other devices include the wash-water bottle and a hose with nozzle connected to a pressurized distilled water tank.

9.4 If stirring apparatus B (Fig. 3) is used, remove the cover cap and connect the cup to a compressed air supply by means of a rubber hose. A air gage must be on the line between the cup and the control valve. Open the control valve so that the gage indicates 1 psi (7 kPa) pressure (Note 10). Transfer the soil-water slurry from the beaker to the air-jet dispersion cup by washing with distilled or demineralized water. Add distilled or demineralized water, if necessary, so that the total volume in the cup is 250 mL, but no more.

Note 10—The initial air pressure of 1 psi is required to prevent the soil-water mixture from entering the air-jet chamber when the mixture is transferred to the dispersion cup.

9.5 Place the cover cap on the cup and open the air control valve until the gage pressure is 20 psi (140 kPa). Disperse the soil according to the following schedule:

Plasticity Index	Dispersion Period min
Under 5	5
6 to 20	10
Over 20	15

Soils containing large percentages of mica need be dispersed for only 1 min. After the dispersion period, reduce the gage pressure to 1 psi preparatory to transfer of soil-water slurry to the sedimentation cylinder.

4

10. Hydrometer Test

10.1 Immediately after dispersion, transfer the soil-water slurry to the glass sedimentation cylinder, and add distilled or demineralized water until the total volume is 1000 mL.

10.2 Using the palm of the hand over the open end of the cylinder (or a rubber stopper in the open end), turn the cylinder upside down and back for a period of 1 min to complete the agitation of the slurry (Note 11). At the end of 1 min set the cylinder in a convenient location and take hydrometer readings at the following intervals of time (measured from the beginning of sedimentation), or as many as may be needed, depending on the sample or the specification for the material under test: 2, 5, 15, 30, 60, 250, and 1440 min. If the controlled water bath is used, the sedimentation cylinder should be placed in the bath between the 2- and 5-min readings.

Note 11—The number of turns during this minute should be approximately 60, counting the turn upside down and back as two turns. Any soil remaining in the bottom of the cylinder during the first few turns should be loosened by vigorous shaking of the cylinder while it is in the inverted position.

10.3 When it is desired to take a hydrometer reading, carefully insert the hydrometer about 20 to 25 s before the reading is due to approximately the depth it will have when the reading is taken. As soon as the reading is taken, carefully remove the hydrometer and place it with a spinning motion in a graduate of clean distilled or demineralized water.

Note 12—It is important to remove the hydrometer immediately after each reading. Readings shall be taken at the top of the meniscus formed by the suspension around the stem, since it is not possible to secure readings at the bottom of the meniscus.

10.4 After each reading, take the temperature of the suspension by inserting the thermometer into the suspension.

11. Sieve Analysis

11.1 After taking the final hydrometer reading, transfer the suspension to a No. 200 (75- μ m) sieve and wash with tap water until the wash water is clear. Transfer the material on the No. 200 sieve to a suitable container, dry in an oven at 230 \pm 9°F (110 \pm 5°C) and make a sieve analysis of the portion retained, using as many sieves as desired, or required for the material, or upon the specification of the material under test.

CALCULATIONS AND REPORT

12. Sieve Analysis Values for the Portion Coarser than the No. 10 (2.00-mm) Sieve

12.1 Calculate the percentage passing the No. 10 sieve by dividing the mass passing the No. 10 sieve by the mass of soil originally split on the No. 10 sieve, and multiplying the result by 100. To obtain the mass passing the No. 10 sieve, subtract the mass retained on the No. 10 sieve from the original mass.

12.2 To secure the total mass of soil passing the No. 4 (4.75-mm) sieve, add to the mass of the material passing the No. 10 sieve the mass of the fraction passing the No. 4 sieve and retained on the No. 10 sieve. To secure the total mass of soil passing the 1/8-in. (9.5-mm) sieve, add to the total mass of soil passing the No. 4 sieve, the mass of the fraction passing the 1/8-in. sieve and retained on the No. 4 sieve. For the remaining sieves, continue the calculations in the same manner.

12.3 To determine the total percentage passing for each sieve, divide the total mass passing (see 12.2) by the total mass of sample and multiply the result by 100.

13. Hygroscopic Moisture Correction Factor

13.1 The hydroscopic moisture correction factor is the ratio between the mass of the oven-dried sample and the air-dry mass before drying. It is a number less than one, except when there is no hygroscopic moisture.

14. Percentages of Soil in Suspension

14.1 Calculate the oven-dry mass of soil used in the hydrometer analysis by multiplying the air-dry mass by the hygroscopic moisture correction factor.

14.2 Calculate the mass of a total sample represented by the mass of soil used in the hydrometer test, by dividing the oven-dry mass used by the percentage passing the No. 10 (2.00-mm) sieve, and multiplying the result by 100. This value is the weight W in the equation for percentage remaining in suspension.

14.3 The percentage of soil remaining in suspension at the level at which the hydrometer is measuring the density of the suspension may be calculated as follows (Note 13): For hydrometer 151H:

$$P = [(100\ 000/W) \times G/(G - G_1)](R - G_1) \tag{1}$$

Note 13—The bracketed portion of the equation for hydrometer 151H is constant for a series of readings and may be calculated first and then multiplied by the portion in the parentheses.

For hydrometer 152H:

$$P = (Ra/W) \times 100 \tag{2}$$

where:

 a = correction faction to be applied to the reading of hydrometer 152H. (Values shown on the scale are computed using a specific gravity of 2.65. Correction factors are given in Table 1),

P = percentage of soil remaining in suspension at the level at which the hydrometer measures the density of the suspension,

R = hydrometer reading with composite correction applied (Section 7).

W = oven-dry mass of soil in a total test sample represented by mass of soil dispersed (see 14.2), g,

G = specific gravity of the soil particles, and

 G_1 = specific gravity of the liquid in which soil particles are suspended. Use numerical value of one in both instances in the equation. In the first instance any possible variation produces no significant effect, and in the second instance, the composite correction for R is based on a value of one for G_1 .

15. Diameter of Soil Particles

15.1 The diameter of a particle corresponding to the percentage indicated by a given hydrometer reading shall be calculated according to Stokes' law (Note 14), on the basis that a particle of this diameter was at the surface of the suspension at the beginning of sedimentation and had settled to the level at which the hydrometer is measuring the density of the suspension. According to Stokes' law: see Table 2

5

TABLE 1. Values of Correction Factor, α, for Different Specific

Gravities of Soil Particles^Δ

Specific Gravity	Correction Factor ⁴
2.95	0.94
2.90	0.95
2.85	0.96
2.80	0.97
2.75	0.98
2.70	0.99
2.65	1.00
2.60	1.01
2.55	1.02
2.50	1.03
2.45	1.05

^4For use in equation for percentage of soil remaining in suspension when using Hydrometer 152H.

$$D = \sqrt{[30n/980(G - G_i)] \times LIT} \tag{3}$$

where:

D = diameter of particle, mm,

- coefficient of viscosity of the suspending medium (in this case water) in poises (varies with changes in temperature of the suspending medium),
- L = distance from the surface of the suspension to the level at which the density of the suspension is being measured, cm. (For a given hydrometer and sedimentation cylinder, values vary according to the hydrometer readings. This distance is known as effective depth (see Table 2)),
- T = interval of time from beginning of sedimentation to the taking of the reading, min,
- G = specific gravity of soil particles, and
- G₁ = specific gravity (relative density) of suspending medium (value may be used as 1.000 for all practical purposes).

Note 14—Since Stokes' law considers the terminal velocity of a single sphere falling in an infinity of liquid, the sizes calculated represent the diameter of spheres that would fall at the same rate as the soil particles.

15.2 For convenience in calculations the above equation may be written as follows: see Table 3

$$D = K\sqrt{LT} \tag{4}$$

where:

- K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3. The value of K does not change for a series of readings constituting a test, while values of L and T do vary.
- 15.3 Values of *D* may be computed with sufficient accuracy, using an ordinary 10-in. slide rule.

Note 15—The value of L is divided by T using the A- and B-scales, the square root being indicated on the D-scale. Without ascertaining the value of the square root it may be multiplied by K, using either the C- or CI-scale.

Sieve Analysis Values for Portion Finer than No. 10 (2.00-mm) Sieve

16.1 Calculation of percentages passing the various sieves used in sieving the portion of the sample from the hydrometer

TABLE 2 Values of Effective Depth Based on Hydrometer and Sedimentation Cylinder of Specified Sizes⁴

Hydrome	eter 151H	Hydrometer 152H					
Actual Hydrometer Reading	Effective Depth, L, cm	Actual Hydrometer Reading	Effective Depth, L, cm	Actual Hydrometer Reading	Effective Depth, L, cm		
1.000	16.3	0	16.3	31	11.2		
1.001	16.0	1	16.1	32	11.1		
1.002	15.8	2	16.0	33	10.9		
1.003	15.5	3	15.8	34	10.7		
1.004	15.2	4	15.6	35	10.6		
1.005	15.0	5	15.5				
1.006	14.7	6	15.3	36	10.4		
1.007	14.4	7	15.2	37	10.2		
1.008	14.2	8	15.0	38	10.1		
1.009	13.9	9	14.8	39	9.9		
1.010	13.7	10	14.7	40	9.7		
1.011	13.4	11	14.5	41	9.6		
1.012	13.1	12	14.3	42	9.4		
1.013	12.9	13	14.2	43	9.2		
1.014	12.6	14	14.0	44	9.1		
1.015	12.3	15	13.8	45	8.9		
1.016	12.1	16	13.7	46	8.8		
1.017	11.8	17	13.5	47	8.6		
1.018	11.5	18	13.3	48	8.4		
1.019	11.3	19	13.2	49	8.3		
1.020	11.0	20	13.0	50	8.1		
1.021	10.7	21	12.9	51	7.9		
1.022	10.5	22	12.7	52	7.8		
1.023	10.2	23	12.5	53	7.6		
1.024	10.0	24	12.4	54	7.4		
1.025	9.7	25	12.2	55	7.3		
1.026	9.4	26	12.0	56	7.1		
1.027	9.2	27	11.9	57	7.0		
1.028	8.9	28	11.7	58	6.8		
1.029	8.6	29	11.5	59	6.6		
1.030	8.4	30	11.4	60	6.5		
1.031	8.1						
1.032	7.8						
1.033	7.6						
1.034	7.3						
1.035	7.0						
1.036	6.8						
1.037	6.5						
1.038	6.2						

AValues of effective depth are calculated from the equation:

$$L = L_1 + 1/2[L_2 - (V_B/A)]$$

where:

L = effective depth, cm,

distance along the stem of the hydrometer from the top of the bulb to

the mark for a hydrometer reading, cm,

 L_2 = overall length of the hydrometer bulb, cm, V_B = volume of hydrometer bulb, cm³, and

V_B = volume of hydrometer bulb, cm³, and
 A = cross-sectional area of sedimentation cylinder, cm²

Values used in calculating the values in Table 2 are as follows: For both hydrometers, 151H and 152H:

 $L_0 = 14.0 \text{ cm}$

 $V_{\rm B} = 67.0 \, {\rm cm}^3$

 $A = 27.8 \text{ cm}^2$

For hydrometer 151H:

., = 10.5 cm for a reading of 1.000

= 2.3 cm for a reading of 1.031

For hydrometer 152H:

1, = 10.5 cm for a reading of 0 g/litre

= 2.3 cm for a reading of 50 g/litre

test involves several steps. The first step is to calculate the mass of the fraction that would have been retained on the No. 10 sieve had it not been removed. This mass is equal to the total percentage retained on the No. 10 sieve (100 minus total

(5)

TABLE 3 Values of K for Use in Equation for Computing Diameter of Particle in Hydrometer Analysis

Temperature,°	Specific Gravity of Soil Particles								
C	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85
16	0.01510	0.01505	0.01481	0.01457	0.01435	0.01414	0.01394	0.01374	0.01356
17	0.01511	0.01486	0.01462	0.01439	0.01417	0.01396	0.01376	0.01356	0.01338
18	0.01492	0.01467	0.01443	0.01421	0.01399	0.01378	0.01359	0.01339	0.01321
19	0.01474	0.01449	0.01425	0.01403	0.01382	0.01361	0.01342	0.1323	0.01305
20	0.01456	0.01431	0.01408	0.01386	0.01365	0.01344	0.01325	0.01307	0.01289
21	0.01438	0.01414	0.01391	0.01369	0.01348	0.01328	0.01309	0.01291	0.01273
22	0.01421	0.01397	0.01374	0.01353	0.01332	0.01312	0.01294	0.01276	0.01258
23	0.01404	0.01381	0.01358	0.01337	0.01317	0.01297	0.01279	0.01261	0.01243
24	0.01388	0.01365	0.01342	0.01321	0.01301	0.01282	0.01264	0.01246	0.01229
25	0.01372	0.01349	0.01327	0.01306	0.01286	0.01267	0.01249	0.01232	0.01215
26	0.01357	0.01334	0.01312	0.01291	0.01272	0.01253	0.01235	0.01218	0.01201
27	0.01342	0.01319	0.01297	0.01277	0.01258	0.01239	0.01221	0.01204	0.01188
28	0.01327	0.01304	0.01283	0.01264	0.01244	0.01255	0.01208	0.01191	0.01175
29	0.01312	0.01290	0.01269	0.01249	0.01230	0.01212	0.01195	0.01178	0.01162
30	0.01298	0.01276	0.01256	0.01236	0.01217	0.01199	0.01182	0.01165	0.01149

percentage passing) times the mass of the total sample represented by the mass of soil used (as calculated in 14.2), and the result divided by 100.

- 16.2 Calculate next the total mass passing the No. 200 sieve. Add together the fractional masses retained on all the sieves, including the No. 10 sieve, and subtract this sum from the mass of the total sample (as calculated in 14.2).
- 16.3 Calculate next the total masses passing each of the other sieves, in a manner similar to that given in 12.2.
- 16.4 Calculate last the total percentages passing by dividing the total mass passing (as calculated in 16.3) by the total mass of sample (as calculated in 14.2), and multiply the result by 100.

17. Graph

17.1 When the hydrometer analysis is performed, a graph of the test results shall be made, plotting the diameters of the particles on a logarithmic scale as the abscissa and the percentages smaller than the corresponding diameters to an arithmetic scale as the ordinate. When the hydrometer analysis is not made on a portion of the soil, the preparation of the graph is optional, since values may be secured directly from tabulated data

18. Report

- 18.1 The report shall include the following:
- 18.1.1 Maximum size of particles,
- 18.1.2 Percentage passing (or retained on) each sieve, which may be tabulated or presented by plotting on a graph (Note 16),
 - 18.1.3 Description of sand and gravel particles:
 - 18.1.3.1 Shape—rounded or angular,
- 18.1.3.2 Hardness—hard and durable, soft, or weathered and friable,
 - 18.1.4 Specific gravity, if unusually high or low,
- 18.1.5 Any difficulty in dispersing the fraction passing the No. 10 (2.00-mm) sieve, indicating any change in type and amount of dispersing agent, and
- 18.1.6 The dispersion device used and the length of the dispersion period.

Note 16—This tabulation of graph represents the gradation of the sample tested. If particles larger than those contained in the sample were removed before testing, the report shall so state giving the amount and maximum size.

- 18.2 For materials tested for compliance with definite specifications, the fractions called for in such specifications shall be reported. The fractions smaller than the No. 10 sieve shall be read from the graph.
- 18.3 For materials for which compliance with definite specifications is not indicated and when the soil is composed almost entirely of particles passing the No. 4 (4.75-mm) sieve, the results read from the graph may be reported as follows:
- (1) Gravel, passing 3-in. and retained on No. 4 sieve %
 (2) Sand, passing No. 4 sieve and retained on No. 200 sieve %
 (a) Coarse sand, passing No. 4 sieve and retained on No. 10 sieve %
 (b) Medium sand, passing No. 10 sieve and retained on No. 40 sieve %
 (c) Fine sand, passing No. 40 sieve and retained on No. 200 sieve %
 (3) Silt size, 0.074 to 0.005 mm
 (4) Clay size, smaller than 0.005 mm
 Colloids, smaller than 0.001 mm

18.4 For materials for which compliance with definite specifications is not indicated and when the soil contains material retained on the No. 4 sieve sufficient to require a sieve analysis on that portion, the results may be reported as follows (Note 17):

SIEVE ANALYSIS

Sieve Size	Percentage Passing
3-in.	
2-in.	
1 ½-in.	
f-in.	
3/4-in.	
%-in.	
No. 4 (4.75-mm)	
No. 10 (2.00-mm)	
No. 40 (425-μm)	
No. 200 (75-µm)	
HYDROMETER ANALYSIS	
0.074 mm	
0,005 mm	
0.001 mm	
0.001 11111	

Note 17—No. 8 (2.36-mm) and No. 50 (300- μ m) sieves may be substituted for No. 10 and No. 40 sieves.

19. Keywords

19.1 grain-size; hydrometer analysis; hygroscopic moisture; particle-size; sieve analysis

STD.ASTM D422-ENGL 1963 WW 0759510 0620340 242

∰ D 422

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocken, PA 19428.



Designation: D 1586 - 84 (Reapproved 1992)⁶¹

AMERICAN SOCIETY FOR TESTING AND MATERIALS 1916 Race St. Philadelphia, Pa 19103 Reprinted from the Annual Book of ASTM Standards. Copyright ASTM If not listed in the current combined Index, will appear in the next edition.

Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils¹

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (*) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DOD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

"Note-Editorial changes were made throughout October 1992.

1. Scope

1.1 This test method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 ASTM Standards:

D 2487 Test Method for Classification of Soils for Engineering Purposes²

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)²

D4220 Practices for Preserving and Transporting Soil Samples²

D 4633 Test Method for Stress Wave Energy Measurement for Dynamic Penetrometer Testing Systems²

3. Terminology

3.1 Descriptions of Terms Specific to This Standard

3.1.1 anvil—that portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

3.1.2 cathead—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope turns around the drum.

3.1.3 drill rods—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.1.4 drive-weight assembly—a device consisting of the

hammer, hammer fall guide, the anvil, and any hammer drop system.

3.1.5 hammer—that portion of the drive-weight assembly consisting of the 140 \pm 2 lb (63.5 \pm 1 kg) impact weight which is successively lifted and dropped to provide the energy that accomplishes the sampling and penetration.

3.1.6 hammer drop system—that portion of the driveweight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.

3.1.7 hammer fall guide—that part of the drive-weight assembly used to guide the fall of the hammer.

3.1.8 N-value—the blowcount representation of the penetration resistance of the soil. The N-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.1.9 ΔN —the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.1.10 number of rope turns—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer, divided by 360° (see Fig. 1).

3.1.11 sampling rods—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.1.12 SPT—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

4. Significance and Use

4.1 This test method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This test method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blow-count, or *N*-value, and the engineering behavior of earthworks and foundations are available.

5. Apparatus

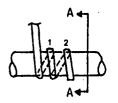
5.1 Drilling Equipment—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be

¹ This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

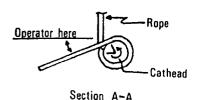
Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D 1586 - 58 T. Last previous edition D 1586 - 67 (1974).

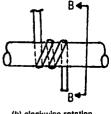
² Annual Book of ASTM Standards, Vol 04.08.

(III) D 1586

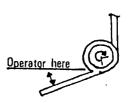


(a) counterclockwise rotation approximately 1% turns





(b) clockwise rotation approximately 21/4 turns



Section B-B

FIG. 1 Definitions of the Number of Rope Turns and the Angle for (a) Counterclockwise Rotation and (b) Clockwise Rotation of the Cathead

suitable for advancing a borehole in some subsurface conditions.

- 5.1.1 Drag, Chopping, and Fishtail Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjuction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharge bits are permitted.
- 5.1.2 Roller-Cone Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.
- 5.1.3 Hollow-Stem Continuous Flight Augers, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).
- 5.1.4 Solid, Continuous Flight, Bucket and Hand Augers, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not cave onto the sampler or sampling rods during sampling.
- 5.2 Sampling Rods—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod which has an outside diameter of 1% in. (41.2 mm) and an inside diameter of 1½ in. (28.5 mm).

NOTE 1—Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the N-values to depths of at least 100 ft (30 m).

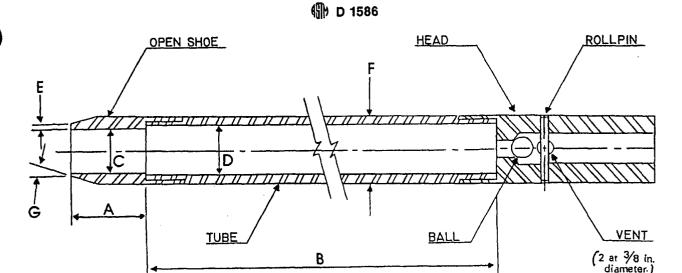
5.3 Split-Barrel Sampler—The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 13% in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sample retainer basket is permitted, and should also be noted on the penetration record if used.

Note 2—Both theory and available test data suggest that N-values may increase between 10 to 30 % when liners are used.

- 5.4 Drive-Weight Assembly:
- 5.4.1 Hammer and Anvil—The hammer shall weigh 140 \pm 2 lb (63.5 \pm 1 kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged.

NOTE 3—It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 Hammer Drop System—Rope-cathead, trip, semiautomatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of



A = 1.0 to 2.0 in. (25 to 50 mm)

B = 18.0 to 30.0 in. (0.457 to 0.762 m)

 $C = 1.375 \pm 0.005$ in. $(34.93 \pm 0.13 \text{ mm})$

D = $1.50 \pm 0.05 - 0.00$ in. $(38.1 \pm 1.3 - 0.0 \text{ mm})$

 $E = 0.10 \pm 0.02 \text{ in.} (2.54 \pm 0.25 \text{ mm})$

 $F \approx 2.00 \pm 0.05 - 0.00$ in. $(50.8 \pm 1.3 - 0.0 \text{ mm})$

G = 16.0° to 23.0°

The 1½ in. (38 mm) Inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

the sampler while re-engaging and lifting the hammer.

5.5 Accessory Equipment—Accessories such as labels, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.5 mm) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method,

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid-auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing

may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid level within the boring or hollowstem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into the borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-

(III) D 1586

kg) hammer and count the number of blows applied in each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

- 7.3 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fraction thereof. The first 6 in. is considered to be a scating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance," or the "N-value." If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6-in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.
- 7.4 The raising and dropping of the 140-lb (63.5-kg) hammer shall be accomplished using either of the following two methods:
- 7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5-kg) hammer and allows it to drop 30 ± 1.0 in. (0.76 m ± 25 mm) unimpeded.
- 7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:
- 7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).
- 7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.
- 7.4.2.3 No more than 21/4 rope turns on the cathead may be used during the performance of the penetration test, as shown in Fig. 1.

NOTE 4—The operator should generally use either 1¾ or 2¼ rope turns, depending upon whether or not the rope comes off the top (1¾ turns) or the bottom (2¼ turns) of the cathead. It is generally known and accepted that 2¾ or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76-m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or the length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent

stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 6-in. (0.15-m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the sampler, make a jar for each stratum and note its location in the sampler barrel.

8. Report

- 8.1 Drilling information shall be recorded in the field and shall include the following:
 - 8.1.1 Name and location of job,
 - 8.1.2 Names of crew,
 - 8.1.3 Type and make of drilling machine,
 - 8.1.4 Weather conditions,
 - 8.1.5 Date and time of start and finish of boring,
- 8.1.6 Boring number and location (station and coordinates, if available and applicable),
 - 8.1.7 Surface elevation, if available,
 - 8.1.8 Method of advancing and cleaning the boring,
 - 8.1.9 Method of keeping boring open,
- 8.1.10 Depth of water surface and drilling depth at the time of a noted loss of drilling fluid, and time and date when reading or notation was made,
 - 8.1.11 Location of strata changes,
 - 8.1.12 Size of casing, depth of cased portion of boring,
 - 8.1.13 Equipment and method of driving sampler,
- 8.1.14 Type sampler and length and inside diameter of barrel (note use of liners),
- 8.1.15 Size, type, and section length of the sampling rods, and
 - 8.1.16 Remarks.
- 8.2 Data obtained for each sample shall be recorded in the field and shall include the following:
 - 8.2.1 Sample depth and, if utilized, the sample number,
 - 8.2.2 Description of soil,
- 8.2.3 Strata changes within sample,
- 8.2.4 Sampler penetration and recovery lengths, and
- 8.2.5 Number of blows per 6-in. (0.15-m) or partial increment.

9. Precision and Bias

- 9.1 Precision—A valid estimate of test precision has not been determined because it is too costly to conduct the necessary inter-laboratory (field) tests. Subcommittee D18.02 welcomes proposals to allow development of a valid precision statement.
- 9.2 Bias—Because there is no reference material for this test method, there can be no bias statement.
- 9.3 Variations in N-values of 100 % or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller, N-values in the same soil can be reproduced with a coefficient of variation of about 10 %.
- 9.4 The use of faulty equipment, such as an extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in N-values obtained between operator-drill rig systems.

4

MI PHE 5474420 042P370 = 48 43*4362 MTZA

∰ D 1586

9.5 The variability in N-values produced by different drill rigs and operators may be reduced by measuring that part of the hammer energy delivered into the drill rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N-value

adjustment is given in Test Method D 4633.

10. Keywords

10.1 blow count; in-situ test; penetration resistance; split-barrel sampling; standard penetration test

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.



AMERICAN SOCIETY FOR TESTING AND MATERIALS 100 Barr Harbor Dr., West Conshotocken, PA 19428 Reprinted from the Annual Book of ASTM Standards. Copyright ASTM Hand listed in the current combined index, will appear in the next addition.

Standard Test Method (Field Procedure) for Withdrawal and Injection Well Tests for Determining Hydraulic Properties of Aquifer Systems¹

This standard is issued under the fixed designation D 4050; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (4) indicates an editorial change since the last revision or reapproval.

1. Scope

- 1.1 This test method describes the field procedure for selecting well locations, controlling discharge or injection rates, and measuring water levels used to analyze the hydraulic properties of an aquifer or aquifers and adjacent confining beds.
- 1.2 This test method is used in conjunction with an analytical procedure such as Test Methods D 4105 or D 4106 to determine aquifer properties.
- 1.3 The appropriate field and analytical procedures are selected as described in Guide D 4043.
- 1.4 The values stated in SI units are to be regarded as standard.
- 1.5 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

- 2.1 ASTM Standards:
- D653 Terminology Relating to Soil, Rock, and Contained Fluids²
- D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)²
- D4043 Guide for Selection of Aquifer-Test Method in Determining Hydraulic Properties by Well Techniques²
- D4105 Test Method (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Modified Theis Nonequilibrium Method²
- D4106 Test Method (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Theis Nonequilibrium Method²
- D 4750 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)²

3. Terminology

3.1 Definitions:

- ¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.
- Current edition approved Oct. 10, 1996. Published February 1997. Originally published as D 4050 91.
 - ² Annual Book of ASTM Standards, Vol 04.08.

- 3.1.1 aquifer, confined—an aquifer bounded above and below by confining beds and in which the static head is above the top of the aquifer.
- 3.1.2 confining bed—a hydrogeologic unit of less permeable material bounding one or more aquifers.
- 3.1.3 control well—well by which the head and flow in the aquifer is changed, for example, by pumping, injection, or change of head.
- 3.1.4 hydraulic conductivity (field aquifer tests)—the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.
- 3.1.5 observation well—a well open to all or part of an aquifer.
- 3.1.6 *piezometer*—a device used to measure hydraulic head at a point in the subsurface.
- 3.1.7 specific storage—the volume of water released from or taken into storage per unit volume of the porous medium per unit change in head.
- 3.1.8 storage coefficient —the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. For a confined aquifer, the storage coefficient is equal to the product of the specific storage and aquifer thickness. For an unconfined aquifer, the storage coefficient is approximately equal to the specific yield.
- 3.1.9 transmissivity—the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit width of the aquifer.
- 3.1.10 For definitions of other terms used in this test method, see Terminology D 653.

4. Summary of Test Method

4.1 This test method describes the field practices in conducting withdrawal and injection well tests. These methods involve withdrawal of water from or injection of water to an aquifer through a control well and measurement of the water-level response in the aquifer. The analysis of the data from this field practice is described in standards such as Test Methods D 4105 and D 4106.

5. Significance and Use

5.1 Withdrawal and injection well test field procedures are used with appropriate analytical procedures in appropriate hydrogeological sites to determine transmissivity and storage coefficient of aquifers and hydraulic conductivity of confining beds.

6. Apparatus

6.1 Various types of equipment can be used to withdraw

∰ D 4050

or inject water into the control well, measure withdrawal and injection rates, and measure water levels. The test procedure may be conducted with different types of equipment to achieve similar results. The objectives to be achieved by the use of the equipment are given in this section and in Sections 7 and 8.

- 6.2 Control Well-Discharge or injection well test methods require that water be withdrawn from or injected into a single well. This well, known as the control well, must be drilled and completed such that it transmits water to or from the aquifer (usually the entire thickness of the aquifer) at rates such that a measurable water level change will occur at observation wells. The control well should be as efficient as possible, to reduce the head loss between the aquifer and the well. Well development should be as complete as possible to eliminate additional production of sand or silt and consequent changes in well efficiency and pumping water levels during the test. The cuttings from the control well should be described and recorded according to Practice D 2488. The analytical method selected for analysis of the data may specify certain dimensions of the control well such as screen length and depth of screen placement. Specific requirements for control wells may be given in standards for specific analytical methods (see, for example, Test Methods D 4105 and D 4106).
- 6.3 Observation Wells or Piezometers—Numbers of observation wells and their distance from the control well and their screened interval may be dependent upon the test method to be employed. Refer to the analytical test method to be used for specifications of observation wells (see, for example, Test Methods D 4105 and D 4106).
- 6.4 Control Well Pump—A pump capable of withdrawal of a constant or predetermined variable rate of water from the control well. The pump and motor should be adequately sized for the designed pumping rate and lift. The pump or motor must be equipped with a control mechanism to adjust discharge rate. In the case of diesel-, gasoline-, or natural-gas-fueled engines, throttle settings should allow for small adjustments in pumping rates. Pumps equipped with electric motors are usually controlled by adjusting backpressure on the pump through a gate valve in the discharge line. Take care to select a discharge rate small enough such that the rate can be maintained throughout the test without fully opening the gate valve. If neither method of control is practical, split the discharge and route part of the discharge back to the well through a separate discharge line.
- 6.5 Many aquifer tests are made at "sites of opportunity," that is, using existing production wells as the control well and using other existing wells for observation of water level. In such cases the locations and screened intervals of the wells should be compatible with the requirements of the method of test analysis.
- 6.6 Water-Level Measurement Equipment—Manual measurements can be made with a steel tape or electric tape as described in Test Method D 4750, with a mechanical recorder linked to a float, or combination of pressure transducer and electronic data logger.
- 6.6.1 Mechanical Recorders—Mechanical recorders employ a float in the well to produce a graphic record of water level changes. Early in the test, it may be difficult to distinguish small increments of time on the recorder chart,

therefore the recorder should be supplemented with additional early time measurements or by marking the trace of an automatic water-level recorder chart and recording the time by the mark. Check the mechanical recorder periodically throughout the test using the steel tape.

6.6.2 Pressure Transducers and Electronic Data Loggers—A combination of a pressure transducer and electronic data logger can provide rapid measurements of water-level change, and can be programmed to sample at reduced frequency late in the test. Select the pressure transducer to measure pressure changes equivalent to the range of expected water level changes. Check the transducer in the field by raising and lowering the transducer a measured distance in the well. Also check the transducer readings periodically with a steel tape.

7. Conditioning

- 7.1 Pre-Test Procedures:
- 7.1.1 Selecting Aquifer-Test Method—Develop a conceptual model of the site hydrogeology and select the appropriate aquifer test method according to Guide D 4043. Observe the requirements of the selected test method with regard to specifications for the control well and observations wells.
- 7.1.2 Field Reconnaissance—Make a field reconnaissance of the site before conducting the test to include as much detail as possible on depth, continuity, extent, and preliminary estimates of the hydrologic properties of the aquifers and confining beds. Note the location of existing wells and water-holding or conveying structures that might interfere with the test. The control should be equipped with a pipeline or conveyance structure adequate to transmit the water away from the test site, so that recharge is not induced near the site. Make arrangements to ensure that nearby wells are turned off well before the test, and automatic pump controls are disabled throughout the anticipated test period. Alternately, it may be necessary to pump some wells throughout the test. If so, they should be pumped at a constant rate, and not started and stopped for a duration equal to that of the test before nor should they be started and stopped during the
- 7.1.3 Testing of Control Well—Conduct a short term preliminary test of the control well to estimate hydraulic properties of the aquifer, estimate the duration of the test and establish a pumping rate for the field procedure.
- 7.1.4 Testing Observation Wells—Test the observation wells or piezometers prior to the aquifer test to ensure that they are hydraulically connected to the aquifer. Accomplish this by adding or withdrawing a known volume of water (slug) and measure the water-level response in the well. The resultant response should be rapid enough to ensure that the water level in the piezometer will reflect the water level in the aquifer during the test. Redevelop piezometers with unusually sluggish response.
- 7.1.5 Measuring Pre-Testing Water-Level Trends—Measure water levels in all observation wells prior to start of pumping for a period long enough to establish the prepumping trend. This period is at least equal to the length of the test. The trend in all observation wells should be similar. A well with an unusual trend may reflect effects of local

∰ D 4050

disturbances in the hydrologic system, or may be inadequately developed.

7.1.6 Selecting of Pumping Rate—Select the pumping rate, on the basis of the preliminary test (see 7.1.3), at which the well is to be pumped, such that, the rate can be sustained by the pump for the duration of the test. The rate should not be so large that the water level is drawn down below the perforations in the control well, causing cascading water and entrained air in the well. Under no circumstances should the rate be so large that the water level is drawn down to the water-entry section of the pump or tailpipe.

8. Procedure

- 8.1 Withdrawing or Injecting Water from the Aquifer-Regulate the rate at which water is withdrawn from, or injected into, the control well throughout the test. The short-term discharge should not vary more than 10 % about the mean discharge. For constant-discharge tests, long-term variation of discharge from the beginning to end of test generally should be less than 5 %.
- 8.2 Measure discharge frequently, for example every 5 min, and if necessary adjust discharge during the beginning of the test. When the discharge becomes more stable, reduce the frequency of adjustments and check discharge at least once every 2 h throughout the test. Variations in electric line load throughout the day will cause variations in discharge of pumps equipped with electric motors. Changes in air temperature and barometric pressure will likewise affect diesel motors. Late in a lengthy test, measure and adjust discharge much more frequently than the water levels are measured.
- 8.3 Measuring Water Level; Frequency of Measurement-Measure water levels in each observation well at approximately logarithmic intervals of time. Measure at least ten data points throughout each logarithmic interval. A typical measurement schedule is listed in Table 1.
- 8.4 Duration of Pumping Phase of Test—Make preliminary analysis of the aquifer-test data during the test using the appropriate test method (such as Test Methods D 4105 and D 4106). Continue the test until the analysis shows adequate test duration.
 - 8.5 Measuring Recovery of Water Levels:
- 8.5.1 If the recovery data are to be analyzed completely as a part of the test and used to determine long-term background water-level changes, the recovery of water levels following pumping phase should be measured and recorded for a period of time equal to the pumping time. Analyze the recovery data to determine the hydraulic parameters of the system. The frequency of measuring water levels should be similar to the frequency during the pumping phase (see Table 1).
 - 8.5.2 If water level data during the early part of the

TABLE 1 Typical Measurement Frequency

Frequency, One Measurement Every:	Elapsed Time, For the First		
30 s	3 min		
1 min	3 to 15 min		
5 min	15 to 60 min		
10 min	60 to 120 min		
20 min	2 to 3 h		
1 h	3 to 15 h		
5 h	15 to 60 h		

recovery phase are to be used from the control well, the pump should be equipped with a foot valve to prevent the column pipe fluid from flowing back into the well when the pump is turned off.

- 8.6 Post-Testing Procedures:
- 8.6.1 Tabulate water levels, including, pre-pumping water levels, for each well or piezometer, date, clock time, time since pumping started or stopped, and measurement point (Test Method D 4750).
- 8.6.2 Tabulate measurements of the rate of discharge or injection at the control well, date, clock time, time since pumping started, and method of measurement.
- 8.6.3 Prepare a written description of each well, describing the measuring point, giving its altitude and the method of obtaining the altitude, and the distance of the measuring point above the mean land surface.
- 8.6.4 Make plots of water-level changes and discharge measurements as follows:
- 8.6.4.1 Plot water levels in the control well and each observation well against the logarithm of time since pumping began. Plot the rate of discharge, Q, of the control well on arithmetic paper.
- 8.6.4.2 Prepare a plot of the log of drawdown, s, versus the log of the ratio of time since pumping began, t, to the square of the distance from the control well to the observation well, r, that is $\log_{10} s$ versus $\log_{10} t/r^2$, on a single graph and maintain the graph as the test progresses. Unexpected, rapid deviations of the data from the type curves may be caused by variations in discharge of the control well, or by other wells in the vicinity starting, stopping or changing discharge rates, or by other changes in field conditions. Such interfering effects may need to be measured, and adjustments made in the final data, or it may be necessary to abort the test.
- 8.6.4.3 Plot Recovery of Water Levels-Plot recovery data, consisting of plots of water level versus log of the ratio of time since pumping started (t) to the time since pumping stopped (t'). Prepare mass plots of log of recovery versus log of the quantity: ratio of time since pumping stopped (t') to the square of the distance from the control well to the observation well (r^2) , that is $\log_{10}t$ versus $\log_{10}t'/r^2$.

9. Report

- 9.1 Prepare a report containing field data including a description of the field site, plots of water level and discharge with time, and preliminary analysis of data.
- 9.1.1 An introduction stating purpose of the test, dates and times water-level measurements were begun, dates and times discharge or injection was begun and ended, and the average rate of discharge or injection.
- 9.1.2 The "as built" description and diagrams of all control wells, observation wells, and piezometers.
- 9.1.3 A map of the site showing all well locations, the distances between wells, and location of all geologic boundaries or surface-water bodies which might effect the test.
- 9.1.3.1 The locations of wells and boundaries that would affect the aquifer tests need to be known with sufficient accuracy to provide a valid analysis. For most analyses, this means the locations must provide data points within plotting accuracy on the semilog or log-log graph paper used in the analysis. Radial distances from the control well to the

4 D 4050

observation wells usually need to be known within ± 0.5 %. For prolonged, large-scale testing it may be sufficient to locate wells from maps or aerial photographs. However, for small-scale tests, the well locations should be surveyed. All faults, streams, and canals or other potential boundaries should be located. When test wells are deep relative to their spacing it may be necessary to conduct well-deviation surveys to determine the true horizontal distance between well screens in the aquifer.

9.1.4 Include tabulated field data collected during the test.

10. Precision and Bias

10.1 It is not practicable to specify the precision of this test method because the response of aquifer systems during aquifer tests is dependent upon ambient system stresses. No statement can be made about bias because no true reference values exist.

11. Keywords

11.1 aquifers; aquifer tests; discharging wells; drawdown; ground water; hydraulic conductivity; injection wells; recovery; storage coefficient; transmissivity

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every live years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend, if you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocken, PA 19428.



AMERICAN SOCIETY FOR TESTING AND MATERIALS 100 Barr Harbor Dr., West Conshohocken, PA 19428 Reprinted from the Annual Book of ASTM Standards, Copyright ASTM If not listed in the current combined index, will appear in the next edition.

Standard Test Method (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Modified Theis Nonequilibrium Method¹

This standard is issued under the fixed designation D 4105; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (e) indicates an editorial change since the last revision or reapproval.

1. Scope

- 1.1 This test method covers an analytical procedure for determining transmissivity and storage coefficient of a nonleaky confined aquifer under conditions of radial flow to a fully penetrating well of constant flux. This test method is a shortcut procedure used to apply the Theis nonequilibrium method. The Theis method is described in Test Method D 4106.
- 1.2 This test method is used in conjunction with the field procedure given in Test Method D 4050.
- 1.3 Limitations—The limitations of this test method are primarily related to the correspondence between the field situation and the simplifying assumptions of this test method (see 5.1). Furthermore, application is valid only for values of u less than 0.01 (u is defined in Eq 2, in 8.6).
- 1.4 The values stated in SI units are to be regarded as
- 1.5 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

- 2.1 ASTM Standards:
- D 653 Terminology Relating to Soil, Rock, and Contained
- D4043 Guide for Selection of Aquifer-Test Method in Determining Hydraulic Properties by Well Techniques²
- D4050 Test Method (Field Procedure) for Withdrawal and Injection Well Tests for Determining Hydraulic Properties of Aquifer Systems²
- D4106 Test Method (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Theis Nonequilibrium Method²

3. Terminology

- 3.1 Definitions:
- 3.1.1 aquifer, confined—an aquifer bounded above and

- below by confining beds and in which the static head is above the top of the aquifer.
- 3.1.2 aquifer, unconfined—an aquifer that has a water table.
- 3.1.3 confining bed—a hydrogeologic unit of less permeable material bounding one or more aquifers.
- 3.1.4 control well—well by which the aguifer is stressed. for example, by pumping, injection, or change of head.
- 3.1.5 drawdown—vertical distance the static head is lowered due to the removal of water.
- 3.1.6 hydraulic conductivity—(field aquifer tests), the volume of water at the existing kinematic viscosity that will move in a unit time under unit hydraulic gradient through a unit area measured at right angles to the direction of flow.
- 3.1.7 observation well—a well open to all or part of an
- 3.1.8 piezometer—use to measure static head at a point in the subsurface.
- 3.1.9 specific storage—the volume of water released from or taken into storage per unit volume of the porous medium per unit change in head.
- 3.1.10 storage coefficient—the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. For a confined aquifer, it is equal to the product of specific storage and aquifer thickness. For an unconfined aquifer, the storage coefficient is approximately equal to the specific yield.
- 3.1.11 transmissivity—the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit width of the aquifer.
- 3.1.12 For definitions of other terms used in this test method, see Terminology D 653.
 - 3.2 Symbols and Dimensions:
 - 3.2.1 K [LT⁻¹]—hydraulic conductivity.
- 3.2.2 K_{xy} —hydraulic conductivity in the horizontal direc-
 - 3.2.3 K_z —hydraulic conductivity in the vertical direction.
 - 3.2.4 $T[L^2T^{-1}]$ —transmissivity.
 - 3.2.5 S [nd]—storage coefficient.
 - 3.2.6 $Ss[L^{-1}]$ —specific storage. 3.2.7 s[L]—drawdown.
- 3.2.8 $Q[L^3T^{-1}]$ —discharge.
- 3.2.9 r[L]—radial distance from control well.
- 3.2.10 t [T]—time.
- 3.2.11 b [L]—thickness of the aquifer.

4. Summary of Test Method

4.1 This test method describes an analytical procedure for

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

Current edition approved Oct. 10, 1996. Published June 1997. Originally published as D 4105 - 91. Last previous edition D 4105 - 91.

² Annual Book of ASTM Standards, Vol 04.08.

(II) D 4105

analyzing data collected during a withdrawal or injection well test. The field procedure (see Test Method D 4050) involves pumping a control well at a constant rate and measuring the water level response in one or more observation wells or piezometers. The water-level response in the aquifer is a function of the transmissivity and coefficient of storage of the aquifer. Alternatively, the test can be performed by injecting water at a constant rate into the aquifer through the control well. Analysis of buildup of water level in response to injection is similar to analysis of drawdown of water level in response to withdrawal in a confined aquifer. Drawdown of water level is analyzed by plotting drawdown against factors incorporating either time or distance from the control well, or both, and matching the drawdown response with a straight line.

4.2 Solution—The solution given by Theis (1)³ can be expressed as follows:

$$s = \frac{Q}{4\pi T} \int_{u}^{\infty} \frac{e^{-y}}{y} \, dy \tag{1}$$

where:

$$u = \frac{r^2 S}{4Tt} \tag{2}$$

and:

$$\int_{u}^{\infty} \frac{e^{-y}}{y} \, dy = W(u) = -0.577216 - \log_{e} u$$

$$+u-\frac{u^2}{2!2}+\frac{u^3}{3!3}-\frac{u^4}{4!4}+\ldots$$
 (3)

4.3 The sum of the terms to the right of $\log_e u$ in the series of Eq 3 is not significant when u becomes small.

Note 1—The errors for small values of u, from Kruseman and DeRidder (1) are as follows:

The value of u decreases with increasing time, t, and decreases as the radial distance, r, decreases. Therefore, for large values of t and reasonably small values of r, the terms to the right of $\log_e u$ in Eq 3 may be neglected as recognized by Theis (2) and Jacob (3). The Theis equation can then be written as follows:

$$s = \frac{Q}{4\pi T} \left[-0.577216 - \ln\left(r^2 \frac{S}{4Tt}\right) \right] \tag{4}$$

from which it has been shown by Lohman (4) that

$$T = \frac{2.3Q}{4\pi\Delta s/\Delta\log_{10}t} \tag{5}$$

and:

$$T = -\frac{2.3Q}{2\pi\Delta s/\Delta\log_{10}r} \tag{6}$$

where:

 $\Delta s/\Delta \log_{10} t$ = the drawdown (measured or projected) over one log cycle of time, and

Δs/Δlog₁₀ r = the drawdown (measured or projected) over one log cycle of radial distance from the control well.

5. Significance and Use

5.1 Assumptions:

5.1.1 Well discharges at a constant rate, Q.

5.1.2 Well is of infinitesimal diameter and fully penetrates the aquifer, that is, the well is open to the full thickness of the aquifer.

5.1.3 The nonleaky aquifer is homogeneous, isotropic, and areally extensive. A nonleaky aquifer receives insignificant contribution of water from confining beds.

5.1.4 Discharge from the well is derived exclusively from storage in the aquifer.

5.1.5 The geometry of the assumed aquifer and well conditions are shown in Fig. 1.

5.2 Implications of Assumptions:

5.2.1 Implicit in the assumptions are the conditions of radial flow. Vertical flow components are induced by a control well that partially penetrates the aquifer, that is, not open to the aquifer through its full thickness. If the control well does not fully penetrate the aquifer, the nearest piezometer or partially penetrating observation well should be located at a distance, r, beyond which vertical flow components are negligible, where according to Reed (5)

$$=\frac{1.5b}{\sqrt{\frac{K_r}{K_{xy}}}}\tag{7}$$

This section applies to distance-drawdown calculations of transmissivity and storage coefficient and time-drawdown calculations of storage coefficient. If possible, compute transmissivity from time-drawdown data from wells located within a distance, r, of the pumped well using data measured after the effects of partial penetration have become constant. The time at which this occurs is given by Hantush (6) by:

$$t = b^2 s / 2T \left(K_r / K_r \right) \tag{8}$$

Fully penetrating observation wells may be placed at less than distance r from the control well. Observation wells may

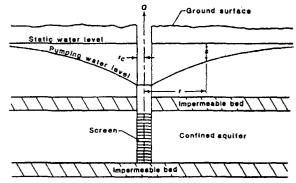


FIG. 1 Cross Section Through a Discharging Well in a Nonleaky
Confined Aquifer

³ The boldface numbers in parentheses refer to a list of references at the end of the text.

御 D 4105

be on the same or on various radial lines from the control well.

5.2.2 The Theis method assumes the control well is of infinitesimal diameter. Also, it assumes that the water level in the control well is the same as in the aquifer contiguous to the well. In practice these assumptions may cause a difference between the theoretical drawdown and field measurements of drawdown in the early part of the test and in and near the control well. Control well storage is negligible after a time, t, given by the following equation after weeks (7).

$$t = \frac{25 r_c^2}{T} \tag{9}$$

where:

 r_c = the radius of the control well in the interval that includes the water level changes.

5.2.3 Application of Theis Nonequilibrium Method to Unconfined Aquifers:

5.2.3.1 Although the assumptions are applicable to confined conditions, the Theis solution may be applied to unconfined aquifers if drawdown is small compared with the saturated thickness of the aquifer or if the drawdown is corrected for reduction in thickness of the aquifer and the effects of delayed gravity yield are small.

5.2.3.2 Reduction in Aquifer Thickness-In an unconfined aquifer, dewatering occurs when the water levels decline in the vicinity of a pumping well. Corrections in drawdown need to be made when the drawdown is a significant fraction of the aquifer thickness as shown by Jacob (8). The drawdown, s, needs to be replaced by s', the drawdown that would occur in an equivalent confined aquifer, where:

$$s' = s - \frac{s^2}{2b} \tag{10}$$

5.2.3.3 Gravity Yield Effects-In unconfined aquifers, delayed gravity yield effects may invalidate measurements of drawdown during the early part of the test for application to the Theis method. Effects of delayed gravity yield are negligible in partially penetrating observation wells at a distance, r, from the control well, where:

$$r = \frac{b}{\sqrt{\frac{K_z}{K_{xy}}}} \tag{11}$$

after the time, t, as given in the following equation from Neuman (9):

$$t = 10S_y \frac{r^2}{T} \tag{12}$$

where:

 S_y = the specific yield. For fully penetrating observation wells, the effects of delayed yield are negligible at the distance, r, in Eq 11 after one tenth of the time given in the Eq 12.

6. Apparatus

6.1 Analysis of data from the field procedure (see Test Method D 4050) by this test method requires that the control

well and observation wells meet the requirements specified in 6.2 through 6.4.

6.2 Control Well-Screen the control well in the aquifer and equip with a pump capable of discharging water from the well at a constant rate for the duration of the test. Preferably, screen the control well throughout the full thickness of the aquifer. If the control well partially penetrates the aquifer, take special precaution in the placement or design of observation wells (see 5.2.1).

6.3 Construction of Observation Wells-Construct one or more observation wells or piezometers at a distance from the control well. Observation wells may be partially open or fully open throughout the thickness of the aquifer.

6.4 Location of Observation Wells-Locate observation wells at various distances from the control well within the area of influence of pumping. However, if vertical flow components are significant and if partially penetrating observation wells are used, locate them at a distance beyond the effect of vertical flow components (see 5.2.1). If the aquifer is unconfined, constraints are imposed on the distance to partially penetrating observation wells and the validity of early time measurements (see 5.2.3).

7. Procedure

7.1 The overall procedure consists of conducting the field procedure for withdrawal or injection well tests described in Test Method D 4050 and analysis of the field data as addressed in this test method.

7.2 Use a graphical procedure to solve for transmissivity and coefficient of storage as described in 8.2.

8. Calculation

8.1 Plot drawdown, s, at a specified distance on the arithmetic scale and time, t, on the logarithmic scale.

8.2 Plot drawdown, s, for several observation wells at a specified time on the arithmetic scale and distance on the logarithmic scale.

8.3 For convenience in calculations, by choosing drawdown, Δs_n as that which occurs over one log cycle of

$$\Delta \log_{10} t = \log_{10} \left(\frac{t_2}{t_1} \right) = 1 \tag{13}$$

and, similarly for convenience in calculations, by choosing the drawdown, Δs_n as that which occurs over one log cycle of distance,

$$\Delta \log_{10} r = \log_{10} \left(\frac{r_2}{r_1} \right) = 1 \tag{14}$$

8.4 Calculate transmissivity using the semilog plot of drawdown versus time by the following equation derived from Eq 5:

$$t = 2.3Q/2\pi\Delta s,\tag{15}$$

or calculate transmissivity using the semilog plot of drawdown versus radial distance from control well by the following equation derived from Eq 6:

$$T = -\frac{2.3Q}{2\pi\Delta s_r} \tag{16}$$

8.5 Determine the coefficient of storage from these

(II) D 4105

semilog plots of drawdown versus time or distance by a method proposed by Jacob (2) where:

$$s = \frac{2.3Q}{4\pi T} \log_{10} \left(\frac{2.25Tt}{r^2 S} \right)$$
 (17)

Taking s = 0 at the zero-drawdown intercept of the straightline semilog plot of time or distance versus drawdown,

$$S = \frac{2.25Tt}{r^2}$$
 (18)

where:

either r or t = the value at the zero-drawdown intercept.

8.6 To apply the modified Theis nonequilibrium method to thin unconfined aquifers, where the drawdown is a significant fraction of the initial saturated thickness, apply a correction to the drawdown in solving for T and S (see 5.2.3.2).

8.7 This test method is applicable only for values of u < 0.01, that is:

$$u = \frac{r^2 S}{4Tt} < 0.01 \tag{19}$$

It is seen from Eq 13 that u decreases as time increases, other things being equal. Because S is in the numerator, the value of u is much smaller for a confined aquifer, whose storage coefficient may range from only about 10^{-5} to 10^{-3} , than for an unconfined aquifer, whose specific yield may be from 0.1 to 0.3. To compensate for this, t must be greater by several orders of magnitude in testing an unconfined aquifer than testing a confined aquifer.

8.7.1 In a drawdown-time test (s versus $\log_{10}t$ or $\log_{10}t/r^2$), data points for any particular distance will begin to fall on a straight line only after the time is sufficiently long to satisfy the above criteria. In a drawdown-distance test (s versus $\log_{10}r$), the well must be pumped long enough that the data for the most distant observation well satisfy the requirements; then only the drawdowns at or after this value of t may be analyzed on a semilogarithmic plot for one particular value of t.

NOTE 2—The analyst may also find it useful to analyze the data using the Theis nonequilibrium procedure (see Test Method D 4106).

9. Report

9.1 Report the information described below. The report of the analytical procedure will include information from the report on test method selection (see Guide D 4043) and the field testing procedure (see Test Method D 4050).

9.1.1 Introduction—The introductory section is intended to present the scope and purpose of the recovery method for determining transmissivity and storativity in a nonleaky confined aquifer. Summarize the field hydrogeologic conditions and the field equipment and instrumentation including the construction of the control well and observation wells

and piezometers, the method of measurement of discharge and water levels, and the duration of the test and pumping rate. Discuss rationale for selecting the modified Theis method.

9.1.2 Hydrogeologic Setting—Review the information available on the hydrogeology of the site; interpret and describe the hydrogeology of the site as it pertains to the selection of this method for conducting and analyzing an aquifer test. Compare the hydrogeologic characteristics of the site as it conforms and differs from the assumptions in the solution to the aquifer test method.

9.1.3 Equipment—Report the field installation and equipment for the aquifer test, including the construction, diameter, depth of screened interval, and location of control well and pumping equipment, and the construction, diameter, depth, and screened interval of observation wells.

9.1.4 Describe the methods of observing water levels, pumping rate, barometric changes, and other environmental conditions pertinent to the test. Include a list of measuring devices used during the test, the manufacturers name, model number, and basic specifications for each major item, and the name and date and method of the last calibration, if applicable.

9.1.5 Testing Procedures—State the steps taken in conducting pre-test, drawdown, and recovery phases of the test. Include the date, clock time, and time since pumping started or stopped for measurements of discharge rate, water levels, and other environmental data recorded during the testing procedure.

9.1.6 Presentation and Interpretation of Test Results:

9.1.6.1 Data—Present tables of data collected during the test. Show methods of adjusting water levels for barometric changes and calculation of drawdown and residual drawdown.

9.1.6.2 Data Plots—Present data plots used in analysis of the data.

9.1.6.3 Evaluate qualitatively the determinations of transmissivity and coefficient of storage on the basis of the adequacy of instrumentation, observations of stress and response, and the conformance of the hydrogeologic conditions, and the performance of the test to the assumptions of the method.

10. Precision and Bias

10.1 It is not practicable to specify the precision of this test method because the response of aquifer systems during aquifer tests is dependent upon ambient system stresses. No statement can be made about bias because no true reference values exist.

11. Keywords

11.1 aquifers; aquifer tests; confined aquifers; control wells; ground water; hydraulic properties; observation wells; storage coefficient; transmissivity; unconfined aquifers

4 D 4105

REFERENCES

- Kruseman, G. P., and DeRidder, N. A., "Analysis and Evaluation of Pumping Test Data," ILRI Publication 47, 1990, p. 377.
- (2) Theis C. V., "The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage," American Geophysical Union Transactions, Vol 16, Part 2, 1935, pp. 519-524.
- (3) Jacob, C. E., "Flow of Ground Water," in Engineering Hydraulics, Proceedings of the Fourth Hydraulics Conference, June 12-15, 1949, New York, John Wiley and Sons, Inc., 1950, pp. 321-386.
- (4) Lohman, S. W., "Ground-Water Hydraulics," U.S. Geological Survey Professional Paper 708, 1972.
- (5) Reed, J. E., "Type Curves for Selected Problems of Flow to Wells in Confined Aquifers," U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter B3, 1980.
- (6) Hantush, M. S., and Jacob, C. E., "Non-Steady Radial Flow in an Infinite Leaky Aquifer," American Geophysical Union Transactions, Vol 36, No. 1, 1955, pp. 95-100.
- (7) Papadopulos, S. S., and Cooper, H. H., Jr., "Drawdown in a Well of Large Diameter," Water Resources Research, Vol 1, 1967, pp. 241-244.
- (8) Jacob, C. E., "Determining Permeability of Water-Table Aquifers," in Bentall, Ray, compiler, Methods of Determining Permeability, Transmissibility, and Drawdown, U.S. Geological Survey Water-Supply Paper 1536-I, 1963, pp. 272-292.
- (9) Neuman, S. P., "Effect of Partial Penetration on Flow in Unconfined Aquifers Considering Delayed Gravity Response," Water Resources Research, Vol 10, No. 2, 1974, pp. 303-312.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any auch patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocker, PA 19428.

Designation: D 4106 - 96

AMERICAN SOCIETY FOR TESTING AND MATERIALS Recrinted from the Annual Book of ASTM Standards. Copyright ASTM If not listed in the current combined index, will appear in the next edition.

Standard Test Method (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Theis Nonequilibrium Method¹

This standard is issued under the fixed designation D 4106; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (e) indicates an editorial change since the last revision or reapproval.

1. Scope

- 1.1 This test method covers an analytical procedure for determining the transmissivity and storage coefficient of a nonleaky confined aquifer. It is used to analyze data on water-level response collected during radial flow to or from a well of constant discharge or injection.
- 1.2 This analytical procedure is used in conjunction with the field procedure given in Test Method D 4050.
- 1.3 Limitations—The limitations of this test method for determination of hydraulic properties of aquifers are primarily related to the correspondence between the field situation and the simplifying assumptions of this test method (see 5.1).
- 1.4 The values stated in SI units are to be regarded as standard.
- 1.5 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

- 2.1 ASTM Standards:
- D 653 Terminology Relating to Soil, Rock, and Contained Fluids²
- D4043 Guide for Selection of Aquifer Test Method in of Hydraulic Properties by Well Determining Techniques²
- D4050 Test Method (Field Procedure) for Withdrawal and Injection Well Tests for Determining Hydraulic Properties of Aquifer Systems²

3. Terminology

- 3.1 Definitions:
- 3.1.1 aquifer, confined—an aquifer bounded above and below by confining beds and in which the static head is above the top of the aquifer.
- 3.1.2 confining bed—a hydrogeologic unit of less permeable material bounding one or more aquifers.
- 3.1.3 control well—well by which the head and flow in the aquifer is changed, for example, by pumping, injection, or imposing a constant change of head.

- 3.1.4 drawdown—vertical distance the static head is lowered due to the removal of water.
 - 3.1.5 head—see head, static.
- 3.1.6 head, static—the height above a standard datum of the surface of a column of water (or other liquid) that can be supported by the static pressure at a given point.
- 3.1.7 hydraulic conductivity (field aquifer tests)—the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.
- 3.1.8 observation well-a well open to all or part of an aquifer.
- 3.1.9 piezometer—a device so constructed and sealed as to measure hydraulic head at a point in the subsurface.
- 3.1.10 specific storage—the volume of water released from or taken into storage per unit volume of the porous medium per unit change in head.
- 3.1.11 storage coefficient—the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. For a confined aquifer, the storage coefficient is equal to the product of the specific storage and aquifer thickness. For an unconfined aquifer, the storage coefficient is approximately equal to the specific yield.
- 3.1.12 transmissivity—the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit width of the aquifer.
- 3.1.13 unconfined aquifer—an aquifer that has a water table.
- 3.1.14 For definitions of other terms used in this test method, see Terminology D 653.
 - 3.2 Symbols and Dimensions:
 - 3.2.1 $K[LT^{-1}]$ —hydraulic conductivity.
- 3.2.2 K_{xy} —hydraulic conductivity in the horizontal plane, radially from the control well.
 - 3.2.3 K_z —hydraulic conductivity in the vertical direction.
 - 3.2.4 $Q[L^3T^{-1}]$ —discharge.
 - 3.2.5 S [nd]—storage coefficient.

 - 3.2.6 S_x [L⁻¹]—specific storage. 3.2.7 T [L²T⁻¹]—transmissivity. 3.2.8 W(u) [nd]—well function of u.
 - 3.2.9 b [L]—thickness of aquifer.
 - 3.2.10 r [L]—radial distance from control well.
 - 3.2.11 s [L]—drawdown.

4. Summary of Test Method

4.1 This test method describes an analytical procedure for analyzing data collected during a withdrawal or injection

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

Current edition approved Oct. 10, 1996. Published June 1997. Originally published as D 4106 - 91.

² Annual Book of ASTM Standards, Vol 04.08.

well test. The field procedure (see Test Method D 4050) involves pumping a control well at a constant rate and measuring the water level response in one or more observation wells or piezometers. The water-level response in the aquifer is a function of the transmissivity and storage coefficient of the aquifer. Alternatively, this test method can be performed by injecting water at a constant rate into the aquifer through the control well. Analysis of buildup of water level in response to injection is similar to analysis of drawdown of water level in response to withdrawal in a confined aquifer. Drawdown of water level is analyzed by plotting drawdown against factors incorporating either time or distance from the control well, or both, and matching the drawdown response with a type curve.

4.2 Solution—The solution given by Theis (1)³ may be expressed as follows:

$$s = \frac{Q}{4\pi T} \int_{u}^{\infty} \frac{e^{-y}}{y} dy \tag{1}$$

where:

$$u = \frac{r^2 S}{4Tt} \tag{2}$$

$$\int_{u}^{\infty} \frac{e^{-y}}{y} dy = W(u)$$

$$= -0.577216 - \log_{e} u + u - \frac{u^{2}}{212} + \frac{u^{3}}{313} - \frac{u^{4}}{414} + \dots$$
 (3)

5. Significance and Use

- 5.1 Assumptions:
- 5.1.1 Well discharges at a constant rate, Q.
- 5.1.2 Well is of infinitesimal diameter and fully penetrates the aquifer.
- 5.1.3 The nonleaky aquifer is homogeneous, isotropic, and aerially extensive. A nonleaky aquifer receives insignificant contribution of water from confining beds.
- 5.1.4 Discharge from the well is derived exclusively from storage in the aquifer.
- 5.1.5 The geometry of the assumed aquifer and well conditions are shown in Fig. 1.
 - 5.2 Implications of Assumptions:
- 5.2.1 Implicit in the assumptions are the conditions of radial flow. Vertical flow components are induced by a control well that partially penetrates the aquifer, that is, the well is not open to the aquifer through its full thickness. If the control well does not fully penetrate the aquifer, the nearest piezometer or partially penetrating observation well should be located at a distance, r, beyond which vertical flow components are negligible, where according to Reed (2):

$$r = 1.5 \frac{b}{\sqrt{\frac{K_x}{K_{xy}}}} \tag{4}$$

This section applies to distance-drawdown calculations of transmissivity and storage coefficient and time-drawdown calculations of storage coefficient. If possible, compute transmissivity from time-drawdown data from wells located within a distance, r, of the pumped well using data measured after the effects of partial penetration have become constant. The time at which this occurs is given by Hantush (3) by:

$$t = b^2 s / 2T (K_r / K_r)$$
 (5)

Fully penetrating observation wells may be placed at less than distance r from the control well. Observation wells may be on the same or on various radial lines from the control well.

5.2.2 The Theis method assumes the control well is of infinitesimal diameter. Also, it assumes that the water level in the control well is the same as in the aquifer contiguous to the well. In practice these assumptions may cause a difference between the theoretical drawdown and field measurements of drawdown in the early part of the test and in and near the control well. Control well storage is negligible after a time, *t*, given by the Eq 6 after Weeks (4).

$$t = 25 \times \frac{r^2 c}{T} \tag{6}$$

where:

 r_c = the radius of the control well in the interval in which the water level changes.

5.2.3 Application of Theis Method to Unconfined Aquifers: 5.2.3.1 Although the assumptions are applicable to artesian or confined conditions, the Theis solution may be applied to unconfined aquifers if drawdown is small compared with the saturated thickness of the aquifer or if the drawdown is corrected for reduction in thickness of the aquifer, and the effects of delayed gravity yield are small.

5.2.3.2 Reduction in Aquifer Thickness—In an unconfined aquifer dewatering occurs when the water levels decline in the vicinity of a pumping well. Corrections in drawdown need to be made when the drawdown is a significant fraction of the aquifer thickness as shown by Jacob (5). The drawdown, s, needs to be replaced by s', the drawdown that would occur in an equivalent confined aquifer, where:

$$s' = s - \left(\frac{s^2}{2b}\right) \tag{7}$$

5.2.3.3 Gravity Yield Effects—In unconfined aquifers, delayed gravity yield effects may invalidate measurements of drawdown during the early part of the test for application to the Theis method. Effects of delayed gravity yield are negligible in partially penetrating observation wells at and beyond a distance, r, from the control well, where:

$$r = \frac{b}{\sqrt{\frac{K_z}{K_{xy}}}} \tag{8}$$

After the time, t, as given in Eq 9 from Neuman (6).

$$t = 10 \times S_{\nu}(r^2/T) \tag{9}$$

where:

 S_y = the specific yield. For fully penetrating observation wells, the effects of delayed yield are negligible at the

³ The boldface numbers in parentheses refer to a list of references at the end of the text.

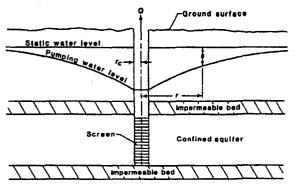


FIG. 1 Cross Section Through a Discharging Well in a Nonleaky **Confined Agulfer**

distance, r, in Eq 8 after one tenth of the time given in the Eq 9.

6. Apparatus

6.1 Analysis of data from the field procedure (see Test Method D 4050) by the method specified in this test method requires that the control well and observation wells meet the specifications in the following paragraphs.

6.2 Construction of Control Well-Screen the control well in the aquifer to be tested and equip with a pump capable of discharging water from the well at a constant rate for the duration of the test. Preferably, screen the control well throughout the full thickness of the aquifer. If the control well partially penetrates the aquifer, take special precaution in the placement and design of observation wells (see 5.2.1).

6.3 Construction of Observation Wells-Construct one or more observation wells at a distance from the control well. Observation wells may be partially open or open throughout the thickness of the aquifer.

6.4 Location of Observation Wells-Locate observation wells at various distances from the control well within the area of influence of pumping. However, if vertical flow components are significant and if partially penetrating observation wells are used, locate them at a distance beyond the effect of vertical flow components (see 5.2.1). If the aquifer is unconfined, constraints are imposed on the distance to partially penetrating observation wells and the validity of early time measurements (see 5.2.3).

7. Procedure

7.1 The overall procedure consists of conducting the field procedure for withdrawal or injection well tests (described in Test Method D 4050) and analysis of the field data that is addressed in this test method.

7.2 The integral expression in Eqs 1 and 2 can not be evaluated analytically. A graphical procedure is used to solve for the two unknown parameters transmissivity and storage coefficient where:

$$s = \frac{Q}{4\pi T} W(u) \tag{10}$$

and:

$$u = \frac{r^2 S}{4Tt} \tag{11}$$

8. Calculation

8.1 The graphical procedure used to calculate test results is based on the functional relations between W(u) and s and between u and t or t/r^2 .

8.1.1 Plot values of W(u) versus 1/u on logarithmic-scale paper (see Table 1). This plot is referred to as the type curve plot.

8.1.2 On logarithmic tracing paper of the same scale and

TABLE 1 Values of Theis Equation W(u) for values of 1/u, From Reed (2)

1/0	1/u × 10 ⁻¹	1	10	10 ²	10 ³	104	108	10 ⁶
1.0	0.000004	0.21938	1.82292	4.03793	6.33154	8.63322	10.93572	13.23830
1.2	0.00003	0.29255	1.98932	4.21859	6.51369	8.81553	11.11804	13.42062
1.5	0.00017	0.39841	2.19641	4.44007	8.73667	9.03866	11.34118	13.64376
2.0	0.00115	0.55977	2.46790	4.72610	7.02419	9.32632	11.62886	13.93144
2.5	0.00378	0.70238	2.68126	4.94824	7.24723	9.54945	11.85201	14.15459
3.0	0.00857	0.82889	2.85704	5.12990	7.42949	9.73177	12.03433	14.33691
3.5	0.01568	0.94208	3.00650	5.28357	7.58359	9.88592	12.18847	14.49108
4.0	0.02491	1.0442B	3.13651	5.41875	7.71708	10.01944	12.32201	14.62459
5.0	0.04890	1.22265	3.35471	5.63939	7.94018	10.24258	12.54515	14.84773
6.0	0.07833	1.37451	3.53372	5.82138	8.12247	10.42490	12.72747	15.03008
7.0	0.11131	1.50661	3.68551	5.97529	8.27659	10.57905	12.88162	15.18421
8.0	0.14641	1.62342	3.81727	6.10865	8.41011	10.71258	13.01515	15.31774
9.0	0.18266	1.72811	3.93367	6.22629	8.52787	10.83036	13.13294	15.43551
1/0	1/u×10 ⁷	108	10°	1010	1011	1012	1013	1014
1.0	15.54087	17.84344	20.14604	22.44862	24.75121	27.05379	29.36638	31.65897
1.2	15.72320	18.02577	20.32835	22.63094	24.93353	27.23611	29.53870	31.84128
1.5	15.94634	18.24892	20.55150	22.85408	25.15668	27.45926	29.76184	32.06442
2.0	16.23401	18.53659	20.83919	23.14177	25.44435	27.74693	30.04953	32.35211
2.5	16.45715	18.76974	21.06233	23.36491	25.66750	27.97008	30.27267	32.57526
3.0	16.63946	18.94206	21.24464	23.54723	25.84982	28.15240	30.45499	32.75757
3.5	16.79362	19.09621	21.39880	23.70139	28.00397	28.30655	30.60915	32.91173
4.0	16.92715	19.22975	21.53233	23.83492	26.13750	28.44008	30.74268	33.04526
5.0	17.15030	19.45288	21.75548	24.05806	26.36064	28.66322	30.96582	33,26840
6.0	17.33263	19.63521	21.93779	24.24039	26.54297	28.84555	31.14813	33.45071
7.0	17.48677	19.78937	22.09195	24.39453	26.69711	28.99969	31.30229	33.60487
8.0	17.62030	19.92290	22.22548	24.52806	26.83064	29.13324	31.43582	33.73840
9.0	17.73808	20.04068	22,34326	24.84584	26,94843	29,25102	31.55360	33.85619

A Value shown as 0.00000 is nonzero but less than 0.000005.

size as the W(u) versus 1/u type curve, plot values of drawdown, s, on the vertical coordinate versus either time on the horizontal coordinate if one observation well is used or versus t/r^2 on the horizontal coordinate if more than one observation well is used.

- 8.1.3 Overlay the data plot on the type curve plot and, while the coordinate axes of the two plots are held parallel, shift the plot to align with the type curve (see Fig. 2).
- 8.1.4 Select and record the values of W(u), 1/u, s, and t at an arbitrary point, referred to as the match point (see Fig. 2), anywhere on the overlapping part of the plots. For convenience the point may be selected where W(u) and 1/u are integer values.

Note 1—Alternatively, the type curve can be constructed by plotting W(u) against u, then plotting the data as s versus r^2/t .

8.1.5 Using the coordinates of the point, determine the transmissivity and storage coefficient from Eqs 12 and 13:

$$T = \frac{QW(u)}{4\pi c} \tag{12}$$

$$S = 4Tu \frac{t}{r^2} \tag{13}$$

8.1.6 To apply the Theis nonequilibrium method to thin unconfined aquifers where the drawdown is a significant fraction of the initial saturated thickness, apply a correction to the drawdown in solving for transmissivity and coefficient of storage (see 5.2.3.2).

9. Report

- 9.1 Prepare a report including the information described in this section. The report of the analytical procedure will include information from the report on test method selection (see Guide D 4043) and the field testing procedure (see Test Method D 4050).
- 9.1.1 Introduction—The introductory section is intended to present the scope and purpose of the constant discharge method for determining transmissivity and storativity in a confined nonleaky aquifer under constant flux. Summarize the field hydrogeologic conditions and the field equipment and instrumentation including the construction of the con-

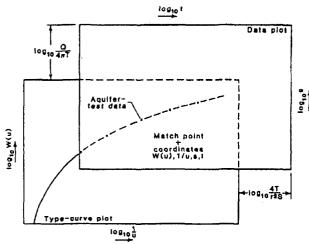


FIG. 2 Relation of 1/u, W(u) Type Curve and t, s Data Plot

trol well and observation wells or piezometers, or both, the method of measurement of discharge and water levels, and the duration of the test and pumping rate. Discuss rationale for selecting the Theis nonequilibrium method.

- 9.1.2 Hydrogeologic Setting—Review the information available on the hydrogeology of the site; interpret and describe the hydrogeology of the site as it pertains to the selection of this test method for conducting and analyzing an aquifer test. Compare the hydrogeologic characteristics of the site as it conforms and differs from the assumptions of this test method.
- 9.1.3 Equipment—Report the field installation and equipment for the aquifer test, including the construction, diameter, depth of screened and gravel packed intervals, and location of control well and pumping equipment, and the construction, diameter, depth, and screened interval of observation wells or piezometers.
- 9.1.4 Describe the methods of observing water levels, pumping rate, barometric changes, and other environmental conditions pertinent to the test. Include a list of measuring devices used during the test, the manufacturers name, model number, and basic specifications for each major item, and the name and date and method of the last calibration, if applicable.
- 9.1.5 Testing Procedures—State the steps taken in conducting pre-test, drawdown, and recovery phases of the test. Include the date, clock time, and time since pumping started or stopped for measurements of discharge rate, water levels, and other environmental data recorded during the testing procedure.
 - 9.2 Presentation and Interpretation of Test Results:
- 9.2.1 Data—Present tables of data collected during the test. Show methods of adjusting water levels for background water-level and barometric changes and calculation of drawdown and residual drawdown.
- 9.2.2 Data Plots—Present data plots used in analysis of the data. Show overlays of data plots and type curve with match points and corresponding values of parameters at match points.
- 9.2.3 Show calculation of transmissivity and storage coefficient.
- 9.2.4 Evaluate qualitatively the test on the basis of the adequacy of instrumentation, observations of stress and response, the conformance of the hydrogeologic conditions, and the performance of the test to the assumptions of this test method.

10. Precision and Bias

10.1 It is not practicable to specify the precision of this test method because the response of aquifer systems during aquifer tests is dependent upon ambient system stresses. No statement can be made about bias because no true reference values exist.

11. Keywords

11.1 aquifers; aquifer tests; control wells; ground water; hydraulic conductivity; observation wells; storage coefficient; transmissivity



REFERENCES

- (1) Theis, C. V., "The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage," American Geophysical Union Transactions, Vol 16, Part 2, 1935, pp. 519-524.
- (2) Reed, J. E., "Type Curves for Selected Problems of Flow to Wells in Confined Aquifers," U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter B3, 1980.
- (3) Hantush, M. S., and Jacob, C. E., "Non-Steady Radial Flow in an Infinite Leaky Aquifer," American Geophysical Union Transactions, Vol 36, No. 1, 1955, pp. 95-100.
- (4) Weeks, E. P., "Aquifer Tests—The State of the Art in Hydrology" in Proceedings of the International Well-Testing Symposium,
- October 19-21, 1977, Berkeley, California, LBL, 7027, Lawrence Berkeley Laboratory, pp 14-26.
- (5) Jacob, C. C., "Determining the Permeability of Water-Table Aquifers," in Bentall, Ray, compiler, "Methods of Determining Permeability, Transmissibility, and Drawdown," U.S. Geological Survey Water-Supply Paper 1536-I, 1963, pp. 245-271.
- (6) Neuman, S. P., "Effect of Partial Penetration on Flow in Unconfined Aquifers Considering Delayed Gravity Response," Water Resources Research, Vol 10, No. 2, 1974, pp. 303-312.
- (7) Wenzel, L. K., "Methods for Determining Permeability of Water-Bearing Materials, with Special Reference to Discharging Well Methods," U.S. Geological Survey Water Supply Paper 887, 1942.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

TEP PEPLIPZO OLZPZED WE DE BEPZE NIZA

Designation: D 5438 - 94

AMERICAN SOCIETY FOR TESTING AND MATERIALS 1916 Race St. Philadelphia, Pa (9103)
Regrinued from the Annual Book of ASTM Standards, Copyright ASTM If not listed in the current combined index, will appear in the next aution.

Standard Practice for Collection of Floor Dust for Chemical Analysis¹

This standard is issued under the fixed designation D 5438; the number immediately following the designation indicates the year of priginal adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A supersempt equiton (4) indicates an editorial change since the last revision or reapproval.

1. Spope

1. This practice covers a procedure for the collection of a sample of dust from carpets and bare floors that can be analyzed for lead, pesticides, or other chemical compounds

and elements.
1.2 This practice is applicable to a variety of carpeted and bare floor surfaces. It has been tested for level loop and plush pile carpets and bare wood floors, specifically.

1.32 This practice is not intended for the collection and evaluation of dust for the presence of aspestos fibers.

1.4. The values stated in SI units are to be regarded as the standärd.

1.5. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.10 ASTM Standards:

D 422 Method for Particle-Size Analysis of Soils²

D 1356 Terminology Relating to Atmospheric Sampling and Analysis³

E (Specification for ASTM Thermometers

E 337 Test Method for Measuring Humidity with a Psychrometer (The Measurement of Wet-Bulb and Dry-Bulb Temperatures)

F 608 Test Method for Evaluation of Carpet-Embedded Dirt Removal Effectiveness of Household Vacuum Cleaners⁵

3. Terminology

3.1 Definitions-For definitions of terms used in this practice, refer to Terminology D 1356.

3.1.1 carpet-embedded dust-soil and other particulate matter, approximately 5-µm equivalent aerodynamic diameter and larger, embedded in carpet pile and normally removable by household vacuum cleaners.

3.1.2 surface dust-soil and other particulate matter, approximately 5-µm equivalent aerodynamic diameter and larger, adhering to floor surfaces and normally removable by household vacuum cleaners.

This practice is under the jurisdiction of ASTM Committee D-22 on Sampling and Analysis of Almospheres and is the direct responsibility of Subcommittee D22.05 on Indoor Air.

Current edition approved June 15, 1994. Published August 1994.

3 Annual Book of ASTM Standards, Vol 11.03.

Annual Book of ASTM Standards, Vol 14.03. Annual Book of ASTM Standards, Vol 15.07.

3 Annual Book of ASTM Standards, Vol 04.08

4. Summary of Practice

4.1 The sampling method described in this practice is taken from work published in Roberts, et al,4.7.8 and Stamper, et al.9

4.2 Particulate matter is withdrawn from the carpet or bare floor by means of a flowing air stream passing through a sampling nozzle at a specific velocity and flow rate and separated mechanically by a cyclone. The cyclone collects particles approximately 5-µm mean aerodynamic diameter and larger. The sampling system allows for height, air flow, and suction adjustments to reproduce systematically a specific air velocity for the removal of particulate matter from carpeted and bare floor surfaces, so that these sampling conditions can be repeated.

4.3 The particulate matter in the air stream is collected in a catch bottle attached to the bottom of the collection cyclone. This catch bottle shall be capped for storage of the sample and transported to the laboratory for analysis.

5. Significance and Use

5.1 This practice may be used to collect dust from carpeted or bare floor surfaces for grayimetric or chemical analysis. The collected sample is substantially unmodified by the sampling procedure.

5.2 This practice provides for a reproducible dust removal rate from level loop and plush carpets, as well as bare floors. It has the ability to achieve relatively constant removal

efficiency at different loadings of surface dust.

5.3 This practice also provides for the efficient capture of somivolatile organic chemicals associated with the dust. The test system can be fitted with special canisters downstream of the cyclone for the capture of specific semivolatile organic chemicals that may volatilize from the dust particles during

5.4 This practice does not describe procedures for evaluation of the safety of floor surfaces or the potential human

Roberts, J. W., and Ruby, M. G., "Development of a High Volume Surface Sampler for Pesticides." U.S. Environmental Protection Agency Report No. EPA 600/4-88/036, Research Triangle Park, NC, January 1989.

Roberts, J. W., Hau, W., and Ruby, M. G., "Evaluation of Dust Samplers for Bare Floors and Uphalstory," Bettelle Subcontract No. 46534(g21733808)-00 03EQ, EPA Prime Contract No. 68-00-0007, U.S. EPA, AREAL, Office of Research and Development, 1993.

*Stamper, V. R., Roberts, J. W., and Ruby, M. G., "Development of a High Volume Small Surfece Sampler for Pesticide and Toxics in House Dust," Research Triangle Institute Report No. RT1/171-01/03F, Research Triangle Park, NC, June 1990. Included in supporting data, which are on file at ASTM Headquarters. Request RR: 022-1010.

Roberts, J. W., Budd, W. T., Ruby, M. G., Stamper, V. R., Camann, D. E., Fortman, R. C., Sheldon, L. S., and Lewis, R. O., "A Small High Volume Surface Sampler HVS3 for Posticides, and Other Toxic Substances in House Dust," Paper No. 91-130,2, 84th Annual Meeting, Air & Waste Management Association, Vancouver, British Columbia, June 16-21, 1991.

JUL. -02'

111

ASTM D5438 94 M 0759510 0541980 159 M

CYCLONE CATCH BOTTLE FLOW CONTROL VALVE WAGNEHELIC GAUGES (2)

FIG. 1 Floor Dust Sampler Using a Commercial Vacuum Cleaner as the Suction Source

exposure to carpet dust. It is the user's responsibility to evaluate the data collected by this practice and make such determinations in the light of other available information.

6. Interferences

6.1 There are no known interferences to the determination of dust loadings covered by this practice.

7. Apparutus

7.1 Sampling Apparatus, which may be acquired commercially 10 (as shown in Fig. 1) or constructed as follows:

7.1.1 The dimensions of the sampling apparatus (nozzle size, cyclone diameter, cyclone inlet diameter, etc.) are interdependent. The flow rate must produce a sufficient velocity both at the sampled surface and in the cyclone. The cyclone must have a cut diameter of 5 µm at the same velocity that will provide a horizontal velocity of 40 cm/s at 10 mm from the nozzle in the carpet material, or 5 mm from the nozzle on bare floors. The fundamental principles of this device have been discussed in detail in Roberts, et al. 6.7.8

7.1.2 Norrie—The edges and corners of the sampling nozzle shall be rounded to prevent catching the curpet material. The nozzle must be constructed to allow for sufficient suction to separate loose particles from the carpet or hare floor and carry them to the cyclone. It must have an adjustment mechanism to establish the nozzle lip parallel to the surface and to achieve the proper suction velocity and pressure drop across the nozzle. A nozzle 12.4 cm long and 1 cm wide, with a 13-mm flange and tapered to the nozzle tubing at no more than 30°, will yield the appropriate velocities when operated as specified in Section 11.

7.1.3 Gaskets—Gaskets in joints should be of a material appropriate to avoid sample contamination.

10 Available from C3, Inc., P.O. Box 5186, Bend, OR 97708,

7.1.4 Cyclone—The cyclone shall be of a specific size such that a given air flow allows for separation of the particles 5-µm mean aerodynamic diameter and larger. The cyclone must be made of aluminum or stainless steel, and the catch bottle must be made of clear glass or fluorinated ethylene propylene (FEP) to avoid contamination and allow the operator to see the sample.

NOZZLE

TEL:7708257261

7.1.5 Flow Control System—The flow control system shall allow for substantial volume adjustment. The suction source must be capable of drawing 12 L/s (26.5 CFM) through the system with no restrictions other than the nozzle, cyclone, and flow control system connected. A commercial vacuum cleaner¹¹ can be used for this purpose.

7.1.6 Flow Measuring and Suction Gages—The use of Magnehelic¹² gages for measurement of the pressure drop at the nozzle and for control of the flow rate for the entire system is considered adequate and applicable for this sampling practice.

7.2 Other Equipment:

7.2.1 Stopwatch.

7.2.2 Masking Tape and Marking Pen, for outlining sections for sampling.

7.2.3 Clean Aluminum Foll and Clean Glass or FEP Jars, for the collection and storage of samples.

7.2.4 Thermometer (see Specification E1).

7.2.5 Relative Humidity Meter (see Test Method E 337).

7.2.6 Shaker Sieve, as specified in Method D 422, with 100 mesh-screen above the pan to separate the fine dust below 150 μ m.

7.2.7 Analytical Balance, sensitive to at least 0.1 mg and having a weighing range from 0.1 mg to 1000 g.

¹¹ The Model 7700Z Royal, available from Royal Appliance Manufacturing Co., Cloreland, OH 44143, or equivalent, has been found to be suitable for this purpose.

¹³ Registered trademark of Dwyer Instruments, Inc., Michigan City, IN 46360.

JUL. -02' 99 (FRI) 09:17

) .)(),..

■ 2PG 48P4P8 G12P27G ■ 4P 8E42G MTZA

₩ D 5438

BAMPLE DATA SHEET

Operator Date Sample Ident. #: _	
Sampling site	
Type of Carpet: Plush Level Loop Multilevel Shag Type of Vacuum: Upright Canister Other	
Last Vacuumed Temp Humidity	&
Comments:	
Location of Area Sampled: Area	_m²
Sketch of Area Sampled:	 =1
Leak Check: Yes_ No_; 20 second cleaning 0 end: Yes _ No	
Total Sample Time:minutesseconds Flow AP Nozzle AP .	
Bottle final Wt:g Tare Wt:g Net Wt:	-a
Pan & Sample Wt:g Pan Tare Wt:g Net Wt:	-ā,
Total Dust: grams/m ² Fine Dust: grams/m ²	
Cyclone Sample #:	-
Lab Sample #:	-

,11.1

■ 457 SBP4420 D42P270 ■ 4P BE420 MT2A

(III) D 5438

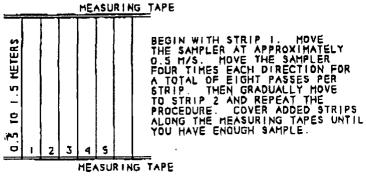


FIG. 3 Example of a Typical Sampling Procedure

8. Resgents and Materials

8.1 Purity of Reagents—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.¹³

8.2 Methanol is required for sampling train cleaning after sample collection.

9. Sampling Strategy

9.1 The overall sampling strategy should be designed to address the goals of the study. Users should consider factors such as foot traffic volume, types of activities, proximity to potential sources, etc. The sampling strategy should be described in the sampling report so it can be taken into consideration when readers are comparing loadings or concentrations, or both, to those obtained from other studies. The ideal sampling location(s) for the beginning of the test procedure are an area that conforms with the protocol for the user's overall sampling strategy. For example, when sampling in a home for child exposure assessment, protocol may require the selection of a carpeted area for sampling where small children play or are likely to play.

10. Pretest Preparation and Calibration

10.1 Calibration—The sampling system described in this practice does not have any calibrated flow devices other than the cyclone and the Magnehelic gages. The cyclone used for the separation of the particles must be designed to give proper separation at varying flow rates throughout the sampling range of the system. The pressure gages and any other devices (that is, temperature gage) used for testing purposes should be calibrated against a primary standard.

10.1.1 Pressure Gages—Pressure gages shall be calibrated against an inclined manometer or other primary standard prior to any field test. One means of checking a Magnehelic gage is to set a flow rate through the sampling system with a manometer and then switch to the Magnehelic gage. If the difference in the readings is more than 3 %, the gage is

10.1.2 The cyclone flow measurement is calibrated with a laminar flow element, spirometer, or roots meter. See the appendix for cyclone calibration with a laminar flow element.

10.2 Pretest Preparation:

10.2.1 Each catch bottle to be used shall be clean and inspected for any contamination. The bottles should be marked with masking tape and a marking pen for identification of the test site, time, and date.

10.2.2 The sampling train shall be inspected to ensure that it has been cleaned and assembled properly.

10.2.3 The sampling train shall be leak-checked prior to sampling. This can be accomplished by placing a mailing envelope or a piece of cardboard beneath the nozzle and switching on the suction source. The flow Magnehetic gage should read 5 Pa (0.02 in. H₂O) or less to ensure that the system is leak free. If any leakage is detected, the system shall be inspected for the cause and corrected before use.

11. Sampling

11.1 Sampling a Carpeted Floor:

11.1.1 Pre-Test Survey—Immediately prior to testing, complete a data form recording all requested information and sketch the area to be sampled. (See Fig. 2 for a sample data form.)

11.1.2 Select a sampling area according to the established protocol for your sampling campaign. This should be determined prior to testing.

11.1.3 A typical sampling procedure may use measuring tapes placed on the carpet so that they are parallel to each other and on either side of the portion of carpet to be sampled (Fig. 3). The measuring tapes should be between 0.5 and 1.5-m apart and extended as far as practical. They should be taped to the carpet with masking tape every 30 cm.

11.1.4 Place the sampler in one corner of the sampling area and adjust the flow rate and pressure drop according to the type of carpet (see 11.8). The two factors that affect the efficiency of the sampling system are the flow rate and pressure drop at the nozzle. The pressure drop at the nozzle is a function of the flow rate and distance between the surface and the nozzle flange.

11.1.5 Clean the wheels and nozzle lip with a clean

leaking or is in need of repair or calibration. This should be done at two different flow rates when checking the gage.

¹³ Reagent Chemicals, American Chemical Society Specifications, American Chemical Society, Washington, DC. For suggestions on the testing of magents not listed by the American Chemical Society, see Analar Standards for Laboratory Chemicals, BOH Ltd., Poole, Donet, U.K., and the United States Pharmacopsia and National Formulary, U.S. Pharmacoustal Convention, Inc. (USPC), Rockyllic, MD.

ME 846 E861450 0157570 III 46 86424 NT2A

∰ D 5438

laboratory tissue¹⁴ immediately before sampling. Begin sampling by moving the nozzle between the ends of the two measuring tapes. The sampler is then moved back and forth four times on the first strip, moving the sampler at approximately 0.5 m/s. (The widths of the strips are defined by the width of the sampling nozzle.) Effective nozzle width is 13 cmifor the CS3 sampler. Move in a straight line between the numbers on the measuring tape. Angle over to the second strip on the next pass gradually, and repeat four double passes. After sampling approximately 0.5 m2, determine the amount of collected material in the bottom of the catch bottle. As a rough estimate, the collection of dust to a depth of 6 mm (0.25 in.) in a 55-mm dismeter catch bottle corresponds to approximately 6 to 8 g. If there is less than 6 mm of dust, sample an additional 0.5 m² next to the area already sampled. Hair, carpet fibers, and other large objects should be excluded from the sample when estimating the quantity collected.

11.1.6 Continue sampling in the area laid out until an adequate sample is collected. Switch off the vacuum. The catch bottle can now be removed, labeled, and capped for storage and analysis. Record the dimensions of the sampled area on the data sheet.

11.1.7 If the rug area to be sampled is very dirty, or has not been cleaned frequently, care must be taken to avoid filling up the cyclone catch bottle on the first sample area. If it is suspected that this will be the case, start with a 0.25-m² sampling area. Then take a second and a third area as before, until the catch bottle is 75 % full.

11.1.8 Adjust the flow rate and nozzle pressure drop to values that approximate those given in Table 1. Use the same flow rate and pressure drop on multilevel and shag carpets as that used for plush carpets.

11.2 Sampling a Bare Floor:

1111

11.2.1 Pre-Test Survey—Immediately prior to testing, complete a data form recording all requested information and sketch the area to be sampled. (See Fig. 2 for sample data form.)

11.2.2 Select a sampling area that is as large as possible and according to the established protocol for your sampling campaign. This should be determined prior to testing. Divide the area into parallel areas 0.5 to 1.5 m apart.

11.2.3 A typical sampling procedure may utilize measuring tapes placed on the floor so that they are parallel to each other and on either side of the portion of floor to be sampled (Fig. 3). The measuring tapes should be between 0.5 and 1.5 m apart and extended as far as practical. They should be taped to the floor every 30 cm with masking tape.

II.2.4 Place the sampler in one corner of the sampling area. Set the height of the nozzle above the floor at approximately I mm (a U.S. penny under the nozzle lip will hold it at this height) and adjust the flow rate (See 11.2.7). The two factors that affect the efficiency of the sampling system are the flow rate and the pressure drop at the nozzle. The pressure drop at the nozzle is a function of the flow rate and the distance between the surface and nozzle flange.

11.2.5 Clean the wheels and nozzle lip immediately before

TABLE 1 Approximate Values for Plow Rate and Nozzle Pressure Drop

Carpet Type	Flow Rate	Nozzia Prassura Drop
Plush	9.5 L/s (20 CFM)	2.2 kPe (9 in. H ₂ O)
Lavel loop	7.8 L/s (18 CFM)	2.5 kPe (10 in. H ₂ O)

sampling with a clean laboratory tissue.14 Begin sampling by moving the nozzle between the ends of the two tapes. The sampler is then moved back and forth two times on the first strip, moving the sampler at approximately 0.5 m/s. (The width of the strips are defined by the width of the sampling nozzle. For the CS₃ sampler, effective nozzle width is 13 cm. Move in a straight line between the numbers on the measuring tape. Gradually angle over to the second strip on the next pass and repeat two double passes. After sampling approximately 10 m2, check the amount of collected material in the bottom of the catch bottle. As a rough estimate, the collection of dust to a depth of 6 mm (0.25 in.) in a 55 mm diameter catch bottle corresponds to approximately 6 to 8 g. If there is less than 6 mm of dust, sample additional areas as available. It may not be possible to obtain 6 g of dust from a clean or small bare floor.

11.2.6 Continue sampling in the area laid out until an adequate sample is collected. Switch off the vacuum. The catch bottle can now be removed, capped, and labeled for storage and analysis. Record the dimensions of the sampled area on the data sheet.

11.2.7 Adjust the flow rate to a flow of 9.5 L/s (20 CFM).

12. Sample Analysis

12.1 After collection of the sample in the catch bottle, the sample may be left in the same bottle or transferred to another container for transport to the laboratory. The procedure for sample handling is different for metals and organic chemicals. Samples for organic analysis should be maintained at 4°C to the extent possible. (Samples should not be frozen before sieving, as this could after the particle size distribution.) Storage at ambient temperature is appropriate for samples that will be analyzed only for metals, but cooling the sample is also acceptable.

12.2 If the sample will be analyzed for pesticides or other organic chemicals, transfer the dust from the cyclone catch bottle onto the middle of a piece of aluminum foil that has been cleaned by washing with pesticide-free methanol or hexane. Fold the foil into a small package carefully, keeping the dust in the middle. Place the foil pouch in a clean glass jar. Cover the jar opening with another piece of precleaned foil and secure the lid to the jar. Seal the seam of the lid to the jar with polytetrafluoroethylene tape. Place the sample jar in an ice chest to keep it cool during transport to the laboratory. Label the jar for reference.

12.3 If the sample will be analyzed for metals, it can be transferred from the catch bottle to a new polyethylene "zipper" seal sample bag. 13 Seal the zipper, and tape the seal with any marking tape that will adhere well to the polyethylene bag. Label the sample for reference.

12.4 Sieve the samples for 5 min in a shaker in accor-

¹⁴ Kimwipes, available from Kimberly-Clarke Corp., Reseell, OA 30076, or equivalent

¹³ Fisherbrand Trademark, evailable from Fisher Supply, 711 Forbes Ave., Pittaburgh, PA 15219, or equivalent.

do

ME 416 4664420 0426270 ME 46 66424 MTZA

(II) D 5438

dance with Method D 422, with a 100-mesh screen above the pan, to determine the weight of fine dust below 150-µm mean diameter.

12.5 Alternative methods for the storage, shipment, and preparation of samples for analysis may be required for some analytes and should be prescribed for specific sampling protocols. The FEP catch-bottle may be used for storage and shipping.

13. Sampler Cleaning

13.1 After the sample bottle is removed, open the flow control valve to maximum flow, tip the sampler back so that the nozzle is approximately 5 cm (2 in.) off the floor, and switch the vacuum ont Place a hand covered by a rubber glove over the bottom of the cyclone and alternate closing and opening the cyclone for 10 s to free any loose material adhering to the walls of the cyclone and tubing. It is not necessary to catch this small amount of dust, as it is usually much less than 1 % of the collected sample.

13.2 Remove the sampler to a well-ventilated cleaning area free of dust. Remove the cyclone and clow at the top of nozzle tubing from the sampler. Use a 50-cm long by 3-cm diameter (20 by 1.25-in.) brush to clean the nozzle, and clean all related items up to and including the cyclone and catch bottle with reagent grade methanol. This wash can be analyzed at the discretion of the operator. The total amount of dust removed in the air and wet cleaning is usually much less than 1 % of the collected dust. The air and wet cleaning is performed to prevent contamination from passing from one sample to another.

14. Data Analysis

- 14:1 Weigh the sieved dust sample with an analytical balance accurate to 0.1 mg.
- 14.2 Calculate the dust weight by subtracting the weight of the pan sample from the final weight according to Method D 422.
- 14.3 Calculate the loading for dust per square metre (g/m²) by dividing the final dust weight by the area sampled (expressed in m²).
 - 14.4 When the analysis results are received from the

TABLE 2 Sampling Efficiency Using Modified Laboratory Test
Method F 5084

Burgatas	Carpet Type		
Parametera	Plush	Level Loop	
Flow rate (L/s)	9.4	7.5	
Della P (kPa)	2.3	2.5	
Mean % of mass collected in cyclone	59.5	6.66	
Blandard deviation	1.2	2.5	
Number of tests	3	3	

^{*} Carpet dust loading was 15.9 g/m*.

taboratory, it is possible to calculate the loading of lead, pesticides, or other analytes per square metre of carpet or bare floor area (µg/m²) in the same way.

14.5 The concentration of any element or chemical associated with the dust may be determined by analysis.

15. Precision and Blas16

15.1 Tests for dust collection efficiency have been performed using Test Method F 608 modified by passing it through a 100-mesh sieve. 6.7 The results are given in Table 2.

15.2 Tests performed with a fine particle filter downstream of the cyclone showed that 99 % or more of the collected test dust was retained in the cyclone catch bottle.^{6.7}

15.3 Tests performed as in 15.2, but with test dust containing lead, showed that 99 % or more of the lead collected was retained in the cyclone catch bottle.^{6.7}

15.4 Tests performed as in 15.2, but with test dust fortified with pesticides, showed that 97 % or more of the pesticides collected were retained in the cyclone catch bottle. The pesticides tested were chlordane, aldrin, chlorpyrifos, heptachlor, and diazinon.

15.5 Tests were conducted on conditioned carpets, as described in Test Method F 608.

16. Keywords

16.1 carpet; cyclone; dust; floors; metals; organic chemicals; particle size; particulate matter; vacuum

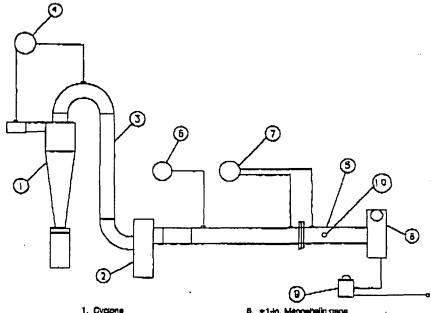
^{*} Pressure drop at nozzie.

¹⁶ Supporting data have been filed at ASTM Headquarters. Request RR:D22-1010.

JU:

1 0E7 2884420 0128270 🛲 PP 8E424 NTZA

∰ D 5438



- 1. Cycone
- Suction/blower
- Flow control valve
- 0 to 10-in. Magnehalic gage
- Laminar flow element
- ±1-in. Megnahelio gaga
- 7. D to 4-in. Magnehelic gage Suction/blower
- Variable autotransformer
- 10. Temperature dage

FIG. X1.1 Calibration Using a Laminar Flow Element

APPENDIX

(Nonmandatory Information)

X1. CALIBRATION OF CYCLONE USING A LAMINAR-FLOW ELEMENT

- X1.1 Assemble the necessary components (see Fig. X1.1).
- X1.1.1 Cyclone.
- X1.1.2 Suction/Blower.
- X1.1.3 Flow Control Valve, 1 to 2.5 kPa (0 to 10 in.).
- X1.1.4 Magnehelic Gage, 1 to 2.5 kPa (0 to 10 in.)
- X1.1.5 Laminar Flow Element (with manufacturer's certified calibration), with pressure gages and dial thermometer.
- X1.1.6 Suction/Blower, with power transformer; leak check the system by plugging the inlet to the cyclone and observing the pressure gage.
 - X1.1.7 Activate Blowers 2 and 8.

X1.1.8 Open the flow control valve on Flow Control Valve 3 so that 2.0 kPa (8.0 in. H₂O) registers on Pressure Gage 4. Then adjust Variable Autotransformer 9 so that 0.0 kPa (0.0 in. H₂O) registers on Pressure Gage 6. Some adjusting of the flow control valve will be necessary.

X1,1.9 Check Pressure Gage 7 for the gas flow reading and record the flow.

X1.1.10 Adjust the flow through the cyclone to 2.5 kPa (10.0 in. H₂O), and repeat the procedure. This action should provide a gas flow rate through the cyclone. This should be between 7.1 and 8.5 L/s (15 to 18 CFM).

The American Society for Teating and Materials takes no position respecting the validity of any patent rights esserted in portrection with any from mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such petent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and If not revised, either resignaved or withdrawn. Your comments are invited either for revision of this standard or for exiditional standards and should be addressed to ASTM Headquarters. Your comments will receive devalul consideration at a meeting of the responsible technical committee, which you may arrand. If you feel that your portments have not received a felt hearing you should make your views known to the ASTM Committee on Standards, 1916 Reca St., Philadalphia, PA 19103.

ATTACHMENT B

FWENC TECHNICAL GUIDELINES

Equipment Calibration and Maintenance Requirements SCI-003:

Purpose

To establish procedures for measuring equipment or instrument calibration and maintenance.

Version Date: 10/01/97 - Revised

Original Issue Date: 07/15/96 Department/Category: Science Document Type: Procedure

Keyword Index: Field Activities/Environmental H&S, Field Activities/Const/Remd/D&D, Field

Activities/Engineering, Field Activities/Environmental Assessments, Field Activities/Operational Readiness, Field Activities/Science, Calibration and Maintenance, Monitoring

Approved by: Donald Region

FOSTER WHEELER ENVIRONMENTAL CORPORATION

NOTICE OF OWNERSHIP AND CONDITIONS OF USE

This document is the property of Foster Wheeler Environmental Corporation (FWENC) and is loaned for use subject to recall for any reason at any time without prior notice and with the distinct understanding that it is to be used only for the duration of and in connection with the performance of work for FWENC. Please observe that the material herein is copyrighted and protected by the laws pertaining to copyright.

Should any circumstances arise under which you will no longer require this document for the specific purpose for which it is loaned to you, it must be returned promptly. Under no circumstance shall this document be transferred or loaned to any other individual, firm, or corporation without the express written permission of the CEO or designee.

In the event such permission is obtained, the person who obtains such permission shall be responsible for obtaining compliance with the conditions set forth in this Notice by any person to whom he/she may loan this document.

This document will be updated periodically as new concepts and practices are developed. Such revisions shall be effected by issuing new or revised sections to ensure uniform practices. Deviations to the enclosed information may be authorized, when appropriate, based upon warranted circumstances.

Sections shall not be removed from this document except as required by revisions or cancellations. Employees are not to rely on printed versions of this document and shall refer to the Lotus Notes database for the most current requirements.

> Copyright © 1996, 1997 Foster Wheeler Environmental Corporation Proprietary Information

Table of Contents

Section

- 1.0 PURPOSE
- 2.0 SCOPE
- 3.0 MAINTENANCE
- 4.0 DEFINITIONS
- 5.0 DISCUSSION
- 6.0 ATTACHMENTS

1.0 PURPOSE

To establish procedures for measuring equipment or instrument calibration and maintenance.

2.0 SCOPE

This procedure applies to scientific projects involved in operating measuring equipment or instruments.

3.0 MAINTENANCE

The Chief Scientist is responsible for updating this procedure. Approval authority for this procedure resides with the Foster Wheeler Environmental Corporation (FWENC) Chief Operating Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Director, Administration and Compliance.

4.0 DEFINITIONS

4.1 Calibration

A step-wise process performed to verify, adjust or systematically standardize the graduations or output of a quantitative measuring device or instrument.

4.2 Equipment/Instrument Calibration and Maintenance Form

A form used to document the calibration and maintenance of all field quantitative measuring equipment or instruments.

4.3 Equipment/Instrument Maintenance

A set of routine or non-routine procedures performed on a piece of quantitative measuring equipment or instrument to keep it in proper operating condition.

4.4 Measuring Equipment/Instrument

Any device utilized to quantitatively measure a parameter.

5.0 DISCUSSION

5.1 Responsibilities

All project field personnel using measuring equipment or instruments in the field are personally responsible for ensuring that the equipment has been properly calibrated prior to its use and that it is maintained in good working order during its utilization. If an exception to this procedure is necessary, the Project or Task Manager shall obtain approval from the Regional Science Manager, and document the exception to the project file, with a copy to the Project QA Officer, Office Science Lead and Regional Science Manager.

The Field Operations Leader (FOL), or designated sampling team member, is responsible for ensuring that all measuring equipment or instruments have been properly calibrated and are maintained according to the equipment or instrument manufacturer's specifications, and that these events are documented on an Equipment/Instrument Calibration and Maintenance Form or in the field logbook. The FOL or designated sampling team member is also responsible for ensuring that all personnel operating measuring equipment or instruments have been trained, if warranted, in the calibration, maintenance and usage of equipment or instruments prior to operation.

5.2 Equipment/Instrument Calibration

All measuring equipment and/or instruments shall be calibrated according to the equipment or instrument manufacturer's specifications on a daily basis (or at the frequency specified by the manufacturer) prior to their use. Exceptions to this requirement shall be permitted for measuring equipment and/or instruments that have fixed calibrations preset by the equipment manufacturer/provider. Additionally, the calibration should be verified periodically at a pre-defined frequency during usage of the equipment or instrument (typically on a daily basis). If at any point during obtaining measurements the user of any equipment or instrument suspects or detects anomalies in the data being generated, the calibration should be checked and verified before proceeding with additional measurements. If a calibration verification check indicates that the equipment or instrument is not within specifications, the resulting data shall be labeled suspect and not used, or the calibration shall be repeated and any measured values that may have been affected shall be checked with the recalibrated equipment or instrument. All personnel utilizing measuring equipment or instruments shall be trained in the calibration and usage of the equipment or instruments prior to operation.

5.3 Equipment/Instrument Maintenance

All measuring equipment and/or instruments shall be maintained according to the equipment or instrument manufacturer's specifications. If during obtaining measurements the user of any equipment or instrument suspects or detects malfunctions, appropriate maintenance shall be performed. All routine or non-routine maintenance shall be performed by personnel who have appropriate skills or training in the type of maintenance required.

5.4 Documentation

The calibration and maintenance of each piece of equipment or instrument shall be documented in the field logbook or on an Equipment/Instrument Calibration and Maintenance Form from the time it is initially obtained for on-site use until final return. A typical Equipment/Instrument Calibration and Maintenance Form is presented in Attachment 1. All Equipment/Instrument Calibration and Maintenance Forms shall be retained by the Project Manager or designee and shall remain in the permanent records kept on-site or in the project file.

6.0 ATTACHMENTS

Attachment 1 - Equipment Calibration and Maintenance Form (Typical Form)

ATTACHMENT 1

FOSTER WHEELER ENVIRONMENTAL CORPORATION EQUIPMENT CALIBRATION AND MAINTENANCE FORM (TYPICAL FORM)

	EQUIP	MENT/ING	STRUMER	AI CALIBI	KA I ION,	EQUIPMENT/INSTRUMEN CALIBRATION AND MAINTENANCE FORM	ANCE FORM
NSTRUMENT (N	JAME / MODE	NSTRUMENT (NAME / MODEL NO. / SERIAL NO.):	NO.):				
AANUFACTURER:_	 				DATE	DATE PURCHASED or LEASED: _	D;
				CALIBRATION LOGSHEET	LOGSHEET		
ALIBRATION DATE	INITIAL	STANDARD(S) USED	PROCEDURE	ADJUSTMENTS	FINAL	SIGNATURE	COMMENTS, A
				MAINTENANCE LOGSHEET	LOGSHEET		
MAINTENANCE DATE		REASON FOR MAINTENANCE	e e	MAINTENANCE PERFORMED	ORMED	SIGNATURE	COMMENTS

ATTACHMENT 1

FOSTER WHEELER ENVIRONMENTAL CORPORATION MICROSOFT WORD VERSION OF EQUIPMENT CALIBRATION AND MAINTENANCE FORM (TYPICAL FORM)

Click the icon below to download and complete the Equipment Calibration and Maintenance form.



Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

SCI-004: Sample Preservation, Chain of Custody, Packaging & Shipping

Purpose

To establish procedures for sample preservation, chain-of-custody and packaging and shipping of environmental and/or other samples.

Version Date: 07/26/96 - New

Original Issue Date:

Department/Category: Science
Document Type: Procedure

Keyword Index: Field Activities/Engineering, Field

Activities/Environmental Assessments, Field Activities/Operational Readiness, Field

Activities/Const/Remd/D&D, Field Activities/Science

Approved by:

Donald Region

FOSTER WHEELER ENVIRONMENTAL CORPORATION

NOTICE OF OWNERSHIP AND CONDITIONS OF USE

This document is the property of Foster Wheeler Environmental Corporation (FWENC) and is loaned for use subject to recall for any reason at any time without prior notice and with the distinct understanding that it is to be used only for the duration of and in connection with the performance of work for FWENC. Please observe that the material herein is copyrighted and protected by the laws pertaining to copyright.

Should any circumstances arise under which you will no longer require this document for the specific purpose for which it is loaned to you, it must be returned promptly. Under no circumstance shall this document be transferred or loaned to any other individual, firm, or corporation without the express written permission of the CEO or designee.

In the event such permission is obtained, the person who obtains such permission shall be responsible for obtaining compliance with the conditions set forth in this Notice by any person to whom he/she may loan this document.

This document will be updated periodically as new concepts and practices are developed. Such revisions shall be effected by issuing new or revised sections to ensure uniform practices. Deviations to the enclosed information may be authorized, when appropriate, based upon warranted circumstances.

Sections shall not be removed from this document except as required by revisions or cancellations. Employees are not to rely on printed versions of this document and shall refer to the Lotus Notes database for the most current requirements.

Copyright © 1996
Foster Wheeler Environmental Corporation
Proprietary Information

Table of Contents

Section

- 1.0 PURPOSE
- 2.0 SCOPE
- 3.0 MAINTENANCE
- 4.0 DEFINITIONS
- 5.0 DISCUSSION
- 6.0 REFERENCES
- 7.0 ATTACHMENTS

1.0 PURPOSE

To establish procedures for sample preservation, chain-of-custody and packaging and shipping of environmental and/or other samples.

2.0 SCOPE

This procedure applies to all professional scientific disciplines involved in collecting and submitting environmental and/or other samples for off-site chemical analysis or other purposes. This procedure does not take precedence over Federal and/or State-specific or project/site-specific requirements for chain-of-custody.

3.0 MAINTENANCE

The Chief Scientist is responsible for updating this procedure. Approval authority for this procedure resides with the Foster Wheeler Environmental Corporation (FWENC) Chief Operating Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Director, Administration and Compliance.

4.0 DEFINITIONS

4.1 Chain-of-Custody Form

A controlled document that accompanies a sample or group of samples at all times as custody of the sample(s) is transferred from one custodian to the subsequent custodian. At each transfer, relinquishing and accepting personnel shall sign, date and note the time that sample custody was transferred.

4.2 Field Log

A permanently bound notebook with sequentially numbered pages used by a field team for recording pertinent information on a real-time basis as samples are collected.

4.3 Sample Custodian

The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes sample custodian.

4.4 Sample Custody

A sample is considered to be in an individual's custody if:

- It is in one's actual physical possession;
- It is in one's view, after being in one's physical possession;
- It is in one's physical possession and locked or otherwise sealed so that tampering will be evident; or,
- It is kept in a secure area, restricted to authorized personnel only.

4.5 Sample Preservation

A means of retarding chemical and/or biological reactions that may occur within a sample that change its physical characteristics and/or degrade analytes of interest in the time interval between the time of sample collection and laboratory analysis or other use. Sample preservation techniques are usually limited to pH control, chemical preservative addition(s) and/or refrigeration/freezing.

5.0 DISCUSSION

5.1 Responsibilities

Project field personnel are personally responsible for ensuring that environmental and/or other samples are properly acquired, preserved (if warranted), and, packaged and shipped (if required). The designated Sample Custodian(s) is(are) personally responsible for the care and custody of samples and maintaining sample custody from the time of sample collection until samples are properly dispatched to their intended destination according to approved procedures.

The Field Operations Leader (FOL), or designated sampling team member, is responsible for initiating all Chain-of-Custody Forms and records for each sample or group of samples. Regional EPA, ACOE or other Federal and State requirements or guidance shall be reviewed and followed where appropriate.

5.2 Sample Acquisition

All samples shall be acquired and containerized following the procedures/protocols stated within the site-specific project plan(s) (i.e., Chemical Data Acquisition Plan (CDAP), Field Sampling and Analysis Plan (FSAP), Quality Assurance Project Plan (QAPjP), or similar plan).

5.3 Documentation

All samples collected shall be traceable from the time the samples are collected until they are analyzed on-site, dispatched to their intended destination, archived for future use, or ultimately disposed of properly. The history of each sample and its handling shall be documented in the Field Log or on a Chain-of-Custody Form, depending upon the requirements stated within the site-specific project plan(s), from the time of field collection through all transfers of custody, until final disposition of the sample material (i.e., archiving, disposal, etc.).

Each sample shipped off-site shall be properly documented to ensure timely, correct and complete analysis for all parameters or required actions requested from the receiving facility (i.e., chemical analysis

taxonomic identification, etc.). Each sample obtained solely for on-site analysis or other on-site purpose shall also be appropriately documented as specified within the site-specific project plan(s). The documentation system presented in this procedure provides the means to individually identify, track and monitor each sample from the point of collection through final data reporting.

Each set of samples shipped off-site shall be accompanied by a Chain-of-Custody Form or other appropriate documentation specified within the site-specific project plan(s) listing the contents of each shipping container. The original form or other required documentation accompanies the samples to their intended destination and a copy is retained by the Project Manager or designee and is placed in the permanent records kept on-site or in the project file.

5.3.1 Field Documentation

Each field team should maintain a permanently bound notebook, referred to as the Field Log. The Field Operations Leader or designee shall record information in this notebook, on a real-time basis, as samples are taken. All samples taken that day should be logged sequentially according to matrix. At a minimum, the following data shall be recorded:

- The names of all persons involved in acquiring samples and a general description of their responsibilities;
- A detailed description of the sample, sampling regimen, sampling devices employed along with their materials of construction, sample containers used and field decontamination performed (if applicable);
- Date and times (military time) over which samples are collected;
- Quality Control samples prepared (if applicable);
- Weather conditions, remarks and observations (if warranted);
- Any specific problems encountered and how they were resolved.

5.3.2 Photographic Documentation

When photographs of samples are taken as part of the documentation procedure, the name of the photographer, date, time, site location and site description shall be entered sequentially in a photographic logbook as photos are taken. Once developed, the photographic prints shall be serially numbered corresponding to the logbook descriptions.

5.3.3 Sample Labels

Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label because a ball-point pen would not function in freezing weather). Any corrections shall be made by drawing a single line through, initialing and dating the error, and then entering the correct information. Erasures or use of correction fluid are not permitted. A typical FWENC sample label is provided in Attachment 1.

A unique sample number shall be used to identify each sample and this number, along with all other information listed on the sample label, shall correspond to that listed in the Field Log or on the Chain-of-Custody Form. Sample labels shall be affixed to each sample container and may be covered with clear, waterproof plastic tape to protect it from smearing if the sample container leaks or gets wet. If required by Federal and/or State agencies, a sample tag is completed and placed on each sample container by means of a rubber band or other fastening device. If required, a custody seal shall be affixed across the top of the sample container in such a manner that if opened or tampered with, the custody seal would be broken. Custody seals may be program-specific (e.g., EPA, ACOE, etc.) or generic Corporate seals depending upon project-specific requirements. A typical FWENC custody seal is shown in Attachment 1. Program-specific sample tags may be provided by Federal and/or State agencies or a duplicate sample label may be used.

5.4 Sample Preservation

All samples shall be preserved as specified in the project-specific sample acquisition plan(s) immediately after collection utilizing the appropriate preservative listed within the required analytical method. Chemical reagents used as preservatives shall be chromatographic/spectroscopic/pesticide/ultrapure grade materials or as appropriate to their intended usage, the analysis performed, and/or the sensitivity of the analytical method. Samples for chemical analysis shall be packed in ice immediately after collection and preservation (if warranted), prior to shipment, in order to lower the temperature of the sample and maintain an internal sample temperature of approximately 4°C.

5.5 Chain-of-Custody Form

Sampling, analysis and custody information about each sample shipped off-site for chemical analysis is recorded on a Chain-of-Custody Form, the original copy of which accompanies the samples following the guidelines provided in the site-specific sample acquisition plan(s). Additional copies of all Chain-of-Custody Forms shall be retained by the Project Manager or designee and shall remain in the permanent records kept on-site or in the project file.

5.6 Transfer of Custody

When transferring possession of samples, the individual(s) relinquishing and receiving shall sign, date and note the time in the Field Log or on the Chain-of-Custody Form. The Field Log or Chain-of-Custody Form provides an unbroken record of all transfers of sample custody between each individual handling the samples or sample shipping container. When samples are shipped off-site, shipping containers should be padlocked or custody sealed for shipment to their intended destination. The method of transport and other pertinent information shall be entered in the "Remarks" section on the custody record. As long as Chain-of-Custody Forms are sealed inside the sample shipping container and custody seals remain intact, commercial carriers are not required to sign-off on the Chain-of-Custody Form.

5.7 Sample Packaging and Shipping

All samples required to be shipped off-site shall be packaged for shipment in compliance with the most current US Department of Transportation, State, local and commercial carrier regulations. All required government and commercial carrier shipping papers shall be filled out and shipment classifications made according to these regulations. Any soil samples originating from and shipped out of a US Department of Agriculture (USDA) quarantined area shall only be shipped to a receiving facility that has a current USDA Permit and approval to properly dispose of soil samples.

5.7.1 Samples for Chemical Analysis

Waterproof, metal or hard plastic ice chests or coolers are the only acceptable type of sample shipping container for samples requiring chemical analysis. All sample containers shall be enclosed and sealed in individual, clear, zip-loc polyethylene (PE) bags so that sample labels and tags (if applicable) are visible. Water and solid samples suspected to be of medium/high concentration or solid samples originating from a site verified to contain dioxin shall be enclosed in a metal can with a clipped or sealable lid (e.g., paint cans). After securing the lid, the metal can shall be custody sealed and labeled with a duplicate sample label affixed to the outside of the can for the sample contained within. Sample containers which do not fit into paint cans shall be double bagged.

Enclosed sample containers shall then be batched together for shipment to the appropriate laboratory. The samples shall be placed in the shipping container which has been lined with a large polyethylene bag and packed with noncombustible absorbent packing material (e.g., vermiculite) surrounding the sample bottles or metal cans containing samples to minimize the possibility of container breakage. Loose ice shall never be used to pack samples.

Water samples for low level organic and low/medium level cyanide analysis shall be cooled to 4°C with ice (water or synthetic blue) when shipped. Shipping with ice is optional for all other sample matrices and analyses. Therefore, the site-specific CDAP/FSAP/QAPjP or other sample acquisition plan(s) should be consulted to determine if these samples shall also be shipped with ice. If required, sufficient water ice shall be sealed in PE bags or synthetic blue ice containers utilized and packed around the samples to cool and maintain the samples at 4°C. After packing, the large plastic bag shall then be sealed.

All original copies of the Chain-of-Custody Forms, and any other sample documentation accompanying the sample shipment shall be enclosed in a waterproof plastic bag and taped to the underside of the shipping container lid. All additional copies of Chain-of-Custody Forms shall be retained by the Project Manager or designee and shall remain in the permanent records kept on-site or in the project file. Shipping containers shall then be sealed with a padlock or custody seals and strapping tape in such a manner that the custody seals would be broken if the shipping container were opened.

All samples for organic analysis shall be shipped within 24 hours of sample collection via a reliable commercial carrier, such as Federal Express, DHL, Airborne Express, etc., or equivalent. Hand delivery is also acceptable if the laboratory is located close to the site. All other samples shall be shipped within the timeframes specified within the site-specific CDAP/FSAP/QAPjP or other sample acquisition plan(s). To facilitate the return of shipping containers, field personnel shall clearly mark the name and address of the return destination on all shipping containers and pre-arrange for return shipment with the subcontracted laboratory. All airbill receipts and other shipping papers shall be retained by the Project Manager or designee and shall remain in the permanent records kept on-site or in the project file.

5.7.2 Samples Not Requiring Chemical Analysis or Originating from Non-contaminated Sites

Samples not requiring chemical analysis or originating from non-contaminated sites shall be packaged and shipped within appropriate sample and shipping containers as specified within the site-specific project plan(s). Although not required for these types of samples, the use of Chain-of-Custody Forms and custody seals is highly recommended.

5.8 Archiving Samples

5.8.1 Samples for Chemical Analysis

<u>Under no circumstances shall samples requiring chemical analysis from contaminated sites be archived within Corporate offices.</u> Whenever possible, samples should be archived on-site.

Any samples to be archived on-site shall be contained within appropriate containers. Once properly labeled and filled, a grease pen is used to mark the level of material in the container and the appropriate container closure is sealed with clear plastic tape over a custody seal. The bottle is placed inside a clear plastic bag, the bag is sealed and the sample is stored inside a 5-gallon plastic bucket or drum surrounded by vermiculite. A vented cover is secured to the 5-gallon bucket or drum (required only for medium/high concentration samples) and two custody seals are applied across opposite sides of the edge of the cover. Archived samples shall be stored at ambient temperature in a secured area away from direct exposure to sunlight.

5.8.2 Samples Not Requiring Chemical Analysis or Originating from Non-contaminated Sites

Samples not requiring chemical analysis or originating from non-contaminated sites shall be archived according to standard industry practices in appropriate containers.

6.0 REFERENCES

USEPA, 1991. User's Guide to the Contract Laboratory Program, OERR, Washington, DC, January, 1991

7.0 ATTACHMENTS

Attachment 1 - Sample Label and Custody Seal (Typical)

Attachment 2 - Chain-of-Custody Form (Typical)

Foster Wheeler Environmental Corporation

ATTACHMENT 1

FOSTER WHEELER ENVIRONMENTAL CORPORATION SAMPLE LABEL (TYPICAL)

SAMPLE NO.:	
PROJECT:	
DATE: / / TIME: HRS	5
MEDIUM: WATER SOIL SEDIMENT OTHER	(Specify)
TYPE: GRAB COMPOSITE OTHER	
PRESERVATION:pH:	_
ANALYSIS:	_
SAMPLED BY:	_
LAB NO.:	
REMARKS:	
CUSTODY SEAL (TYPICAL)	
CUSTODY SEAL	

Foster Wheeler Environmental Corporation Proprietary Information

(Signature)

Person Collecting Sample:_

Date Collected:

_ Sample No.:_

__ Time Collected:_

ATTACHMENT 1

FOSTER WHEELER ENVIRONMENTAL CORPORATION MICROSOFT WORD VERSION OF SAMPLE LABEL (TYPICAL)

Click the icon below to download and complete the Performance Appraisal form.



Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

ATTACHMENT 2 CHAIN-OF-CUSTODY FORM (TYPICAL)

PROJECT				ERS		}											<u> </u>	PRESERVATION	Z
SAMPLERS: (Signeture)				NIATHO:	<u> </u>												. 03	SPECIFY CHEMICALS	្ត
SAMPLE NUMBER	DATE	TIME	COMP.	<u> </u>							<i>`.</i>			SAM	REMARKSOR SAMPLE LOCATION	KS)	FINAL PH	7.2
									<u> </u>								_ :		
			+	<u> </u>			\dagger	+	+	_ _			\dagger						
	- 1	1	+-	-	\downarrow		+	\dagger	+-	-			\dagger				_		Τ
			-	-				-	-	-									
			-	-	_				_	_									
		 - - - -	-	-	-	E	-	 - -	-	:			:				ا ند		-
		-	-	-	_		\vdash												
								-	_	_									
			-	_	_														
		-	\vdash	_							·						4		
	: : : : :	:	1:	: -				· :	: 1			•	:						-
			-						Н								_		\neg
									_								4		\neg
			-		_				- ;			:	-				-		:]
Relinquished by: (Signatura)	Date Date	Time	E.	Received by: (Signature)	/: (Sig	(Signature)	. :	:	nbujje	Relinquished by: (Signature)	5y: (S)	gnetu	(Signeture) (4)	Date	e / Time	Shipped via:			:
Relinquished by: (Signeture) (2)	Date	Time	Rec	Received by: (Signature)	is) :	nature		E 3	Signatu	Received for Laboratory by: (Signature)	abora	tory	: پا	Ö	Date / Time	Shipping Ticket No.	Ticke	No.	
Relinquished by: (Signature)	+	Time	Rece	Received by: (Signature)	Sign	ature.		E.	Hemarks									·	
								l	ľ										

Foster Wheeler Environmental Corporation Proprietary Information

FOSTER WHEELER ENVIRONMENTAL CORPORATION

ATTACHMENT C

NJDEP FIELD SAMPLING PROCEDURE

R:\TECH\RAC\CORNELL\FSP\fsp.WPD

300231

Appendix 7-1

NJDEPE MONITOR WELL SPECIFICATIONS FOR BEDROCK, UNCONSOLIDATED AND CONFINED AQUIPERS

A. MONITORING WELL REQUIREMENTS FOR BEDROCK FORMATION

Revised 3/92

- 1. State well permits are required for each monitoring well installed and the well must be constructed by a New Jersey-licensed well driller of the proper class.
- 2. The State well permit number must be prominently displayed and permanently affixed to each monitoring well. Each well must also have a site-specific well identification number permanently affixed (e.g., MW-1).
- Copies of the site-specific well specifications and State approved well permit must be maintained at the drilling site by the driller.
- 4. The borehole drilled to case off the overburden must extend a minimum of 10 feet into competent bedrock.
- 5. Any borehole that is to have a casing installed and grouted, must be a minimum of 4 inches greater than the immediate casing it surrounds.
- 6. When completed, the open borehole interval of the well shall not exceed 25 feet in length. If a well screen and riser pipe are placed in the bedrock borehole, no more than 25 feet of screen will be allowed and no more than 5 feet of filter pack will be allowed above the top of the screen. If a well screen and riser pipe are to be installed in the bedrock borehole, applicable well specifications for unconsolidated wells must be adhered to.
- 7. The use of glues or solvents is prohibited in the installation of well screens, riser pipes and well casings.
- 8. Acceptable well grouting procedures:
 - a. The following materials shall be acceptable for the grouting of the annular space between the casing and the oversize borehole.
 - i. Portland Neat Cement In accordance with Table 1
 - ii. Portland Cement/High Grade Bentonite In accordance with Table 2
 - iii. High Grade Bentonite In accordance with Table 3

Table 1 - Portland Cement

Type of Cement	Pounds of Cement	Gallons of Water	Target Density lbs/gal	Acceptable Density Range lbs/gal	Water to Cement Ratio
I & II	94	5.2	15.6	15.9 to 16.3	0.46
III	94	6.3	14.8	14.2 to 15.5	0.56

Table 2 - Portland Cement/High Grade Bentonite * - Only Portland Cement Types I or II

Pounds	Pounds	Gallons	Target	Acceptable	Water to
of	of	of	Density	Density Range	Cement
Bentonite	Cement	Water	lbs/gal	lbs/gal	Ratio
5.0	94	8.3	13.9	13.4 to 14.5	0.74

Table 3 - High Grade Bentonite * - Numbers Based on 15 to 30% Solids by Weight

Pounds	Target	Acceptable Range of Water (gallons) **	Target	Acceptable
of	Gallons of		Density	Density Range
Bentonite	Water**		lbs/gal*	lbs/gal*
50	18	14-34	9.8	9.2 to 10.2

- * Accurate Measurement of materials prior to mixing is imperative as air entrainment during the physical mixing of the slurry tends to decrease the density of the mixture.
- ** Bentonite Products and additives should be mixed in accordance with manufacturers specifications.
- b. When using straight bentonite Bentonite shall not be used for grouting in those instances where it will come in contact with ground water having a pH less than 5.0 and/or a Total Dissolved Solids content in excess of 1,000 ppm.
- c. Where the grouting material extends through zones of salt water, a salt/water resistant grout material shall be used.

9. Grout Placement

a. Pressure Grouting - The grout shall be pumped, through a tremie/grout pipe, in one continuous operation, from the bottom to the top of the annular space. The tremie /grout pipe may be slowly raised as the grout is being placed but the discharge end of the pipe shall remain submerged in the grout at all times until grouting is complete.

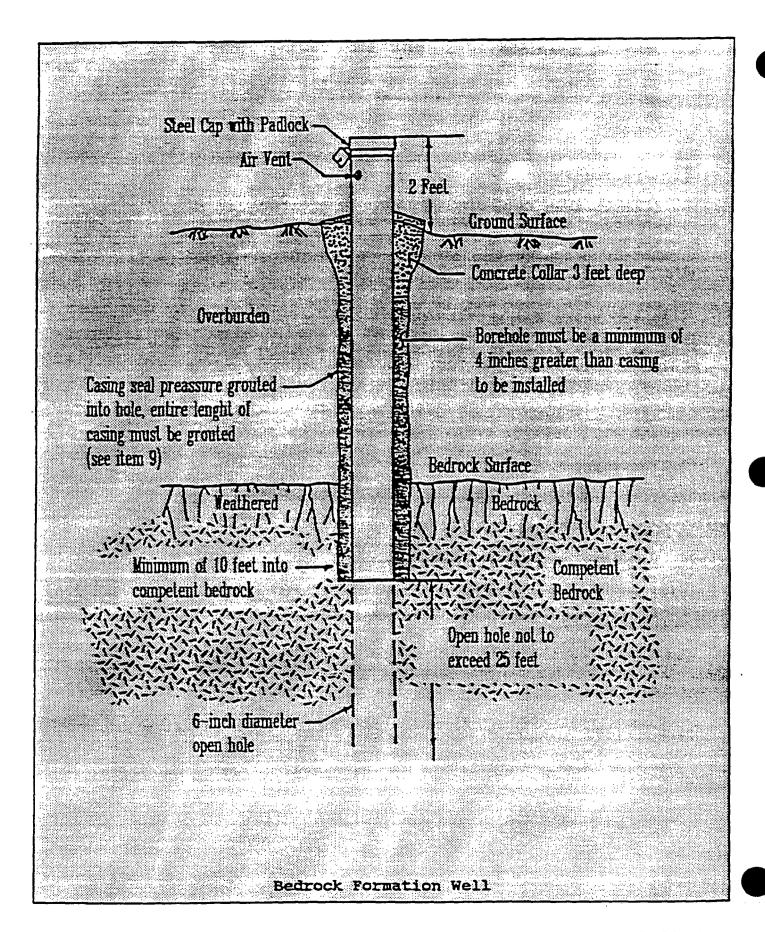
- b. Gravity Displacement Limited to consolidated wells. A sufficient quantity of grout shall be pumped under pressure so as to displace all materials from the oversize borehole to insure that the annular space will be completely filled with grout prior to the emplacement of a plugged casing into the borehole.
- 10. Potable water must be used for mixing grouting materials and drilling fluids.
- 11. The driller must maintain an accurate written log of all materials encountered, record construction details for each well, and record the depth of each water bearing zone. This information must be submitted to the Bureau of Water Allocation as required by N.J.S.A. 58:4A-14.
- 12. The protective steel casing shall be installed to a minimum depth of 3 feet below grade, equipped with a locking cap and be securely set in concrete, as shown in the diagram. The locking cap must be made of steel. Flush-mount monitoring wells are acceptable provided they have manholes, locking caps, and seals to prevent leakage of surface water into the well.
- 13. Top of the innermost casing (excluding cap) must be surveyed to the nearest 0.01 foot by a New Jersey-licensed surveyor. The survey point shall be the highest point of the casing. The survey point must be marked on each well.
- 14. Wells should be developed to a turbid-free discharge.

Notice is Hereby Given of the Following:

The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable, or other structures.

The permittee (applicant) is solely responsible for the safety and adequacy of the design and construction of monitoring well(s) required by the Department.

The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.



B. MONITOR WELL REQUIREMENTS FOR UNCONSOLIDATED AQUIFERS

11.

Revised 3/92

- 1. State well permits are required for each monitoring well installed and the well must be constructed by a New Jersey-licensed well driller of the proper class.
- 2. The State well permit number must be prominently displayed and permanently affixed to each monitoring well. Each well must have a site specific well identification number permanently affixed (e.g., MW-1).
- 3. Copies of the site-specific well specifications and State approved well permit must be maintained at the drilling site by the driller.
- 4. Minimum screen and riser pipe inner diameter is 2 inches.
- 5. The use of glues or solvents is prohibited in the installation of well screens, riser pipes and well casing.
- 6. Any borehole that is to have a casing installed and grouted, must be a minimum of 4 inches greater than the immediate casing it surrounds.
- 7. In order to prevent any induced interconnection between the overburden/weathered bedrock and competent bedrock, the well screen shall not extend across the aforementioned interface.
- 8. Wells must have a filter pack installed.
- 9. No more than 25 feet of well screen shall be installed and no more than 5 feet of filter pack shall be placed above the top of the well screen.
- 10. Acceptable well grouting procedures:
 - a. The following materials shall be acceptable for the grouting of the annular space between the casing and the oversize borehole.
 - i. Portland Neat Cement In accordance with Table 1
 - ii. Portland Cement/High Grade Bentonite In accordance with Table 2
 - iii. High Grade Bentonite In accordance with Table 3

Table 1 - Portland Cement

Type of <u>Cement</u>	Pounds of Cement	Gallons of Water	Target Density lbs/gal	Acceptable Density Range lbs/gal	Water to Cement Ratio
I & II	94	5.2	15.6	15.9 to 16.3	0.46
III	94	6.3	14.8	14.2 to 15.5	0.56

Table 2 - Portland Cement/High Grade Bentonite * - Only Portland Cement Types I or II

Pounds	Pounds	Gallons	Target	Acceptable	Water to
of	of	of	Density	Density Range	Cement
Bentonite	Cement	Water	lbs/qal	lbs/gal	<u>Ratio</u>
5.0	94	8.3	13.9	13.4 to 14.5	0.74

Table 3 - High Grade Bentonite * - Numbers Based on 15 to 30% Solids by Weight

Pounds	Target	Acceptable	Target	Acceptable
of	Gallons of	Range of Water	Density	Density Range
Bentonite	Water**	(gallons)**	lbs/gal*	lbs/gal*
50	18	14-34	9.8	9.2 to 10.2

- * Accurate Measurement of materials prior to mixing is imperative as air entrainment during the physical mixing of the slurry tends to decrease the density of the mixture.
- ** Bentonite Products and additives should be mixed in accordance with manufacturers specifications.
- b. When using straight bentonite Bentonite shall not be used for grouting in those instances where it will come in contact with ground water having a pH less than 5.0 and/or a Total Dissolved Solids content in excess of 1,000 ppm.
- c. Where the grouting material extends through zones of salt water, a salt/water resistant grout material shall be used.

11. Grout Placement

- a. Pressure Grouting The grout shall be pumped, through a tremie pipe, in one continuous operation, from the bottom to the top of the annular space. The tremie /grout pipe may be slowly raised as the grout is being placed but the discharge end of the pipe shall remain submerged in the grout at all times until grouting is complete.
- b. When grouting the annular space around a well casing or riser pipe, the grout must extend up to the ground surface.

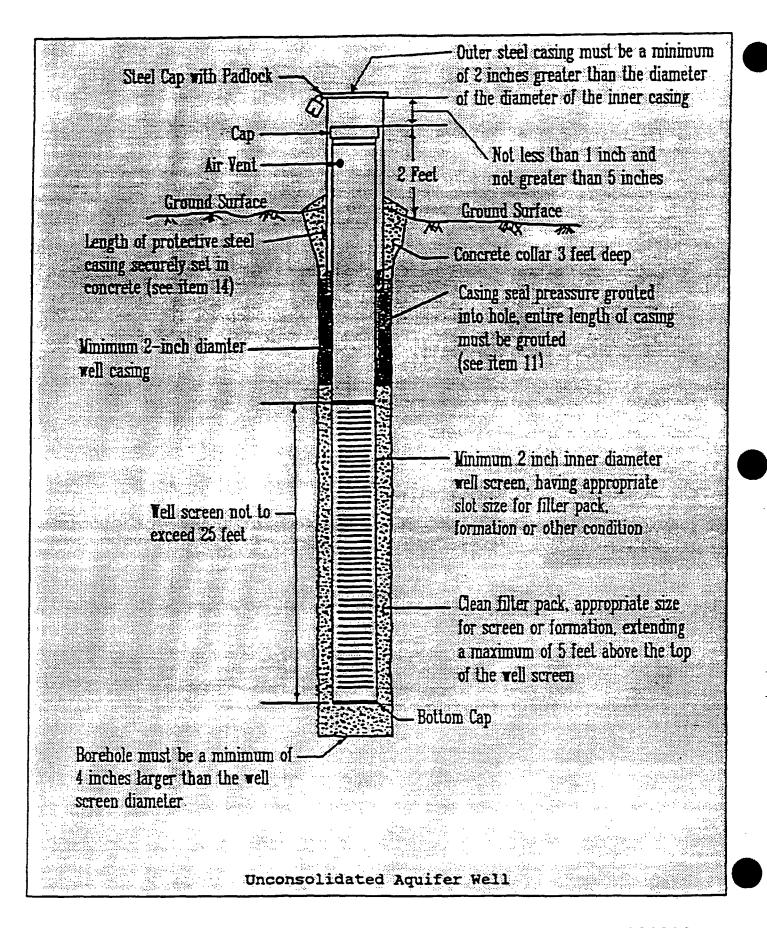
- c. When grouting the annular space directly above a filter pack, the grout should be discharged horizontally from the tremie pipe.
- 12. Potable water must be used for mixing grouting materials and drilling fluids.
- 13. The driller must maintain an accurate written log of all materials encountered, record construction details for each well, and record the depth of each water bearing zone. This information must be submitted to the Bureau of Water Allocation as required by N.J.S.A. 58:4A-14.
- 14. The protective steel casing shall be installed to a minimum depth of 3 feet below grade, equipped with a locking cap and securely set in concrete, as shown in the diagram. The locking cap must be made of steel. Flush-mount monitoring wells are acceptable provided they have manholes, locking caps, and seals to prevent leakage of surface water into the well.
- 15. Top of the innermost casing (excluding cap) must be surveyed to the nearest 0.01 foot by a New Jersey-licensed surveyor. The survey point shall be the highest point of the casing. The survey point must be marked on each well.
- 16. Wells should be developed to a turbid-free discharge.

Notice is Hereby Given of the Following:

The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable, or other structures.

The permittee (applicant) is solely responsible for the safety and adequacy of the design and construction of monitoring well(s) required by the Department.

The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.



C. MONITOR WELL REQUIREMENTS FOR CONFINED UNCONSOLIDATED AQUIFERS

Revised 3/92

- State well permits are required for each monitoring well installed and the well must be constructed by a New Jersey-licensed well driller of the proper class.
- 2. The State well permit number must be prominently displayed and permanently affixed to each monitoring well. Each well must have a site-specific well identification number permanently affixed (e.g., MW-1).
- 3. Copies of the site-specific well specifications and State approved well permit must be maintained at the drilling site by the driller.
- 4. Minimum screen and riser pipe inner diameter is 2 inches.
- 5. The use of glue or solvents is prohibited in the installation of well screens, riser pipes and well casing.
- 6. Any borehole that is to have a casing installed and grouted, must be a minimum of 4 inches greater than the immediate casing it surrounds.
- 7. In order to prevent any induced interconnection between the overburden/weathered bedrock and competent bedrock, the well screen shall not extend across the aforementioned interface.
- 8. Wells must have a filter pack installed.
- 9. No more than 25 feet of well screen shall be installed and no more than 5 feet of filter pack shall be placed above the top of the well screen.
- 10. Under no circumstances shall the filter pack extend into a confining layer.
- 11. Acceptable well grouting procedures:
 - a. The following materials shall be acceptable for the grouting of the annular space between the casing and the oversize borehole.
 - i. Portland Neat Cement In accordance with Table 1
 - ii. Portland Cement/High Grade Bentonite In accordance with Table 2
 - iii. High Grade Bentonite In accordance with Table 3

Table 1 - Portland Cement

Type of Cement	Pounds of Cement	Gallons of Water	Target Density lbs/qal	Acceptable Density Range lbs/gal	Water to Cement Ratio
I & II	94	5.2	15.6	15.9 to 16.3	0.46
III	94	6.3	14.8	14.2 to 15.5	0.56

Table 2 - Portland Cement/High Grade Bentonite
 * - Only Portland Cement Types I or II

Pounds	Pounds	Gallons	Target	Acceptable	Water to
of	of	of	Density	Density Range	Cement
Bentonite	Cement	Water	lbs/gal	lbs/gal	Ratio
5.0	94	8.3	13.9	13.4 to 14.5	0.74

Table 3 - High Grade Bentonite
* - Numbers Based on 15 to 30% Solids by Weight

Pounds	Target	Acceptable Range of Water (gallons) **	Target	Acceptable
of	Gallons of		Density	Density Range
Bentonite	Water**		lbs/gal*	lbs/gal*
50	18	14-34	9.8	9.2 to 10.2

- * Accurate Measurement of materials prior to mixing is imperative as air entrainment during the physical mixing of the slurry tends to decrease the density of the mixture.
- ** Bentonite Products and additives should be mixed in accordance with manufacturers specifications.
- b. When using straight bentonite Bentonite shall not be used for grouting in those instances where it will come in contact with ground water having a pH less than 5.0 and/or a Total Dissolved Solids content in excess of 1,000 ppm.
- c. Where the grouting material extends through zones of salt water, a salt/water resistant grout material shall be used.

12. Grout Placement

- a. Pressure Grouting The grout shall be pumped, through a tremie pipe, in one continuous operation, from the bottom to the top of the annular space. The tremie /grout pipe may be slowly raised as the grout is being placed but the discharge end of the pipe shall remain submerged in the grout at all times until grouting is complete.
- b. When grouting the annular space around a well casing or riser pipe the grout must extend up to the ground surface.

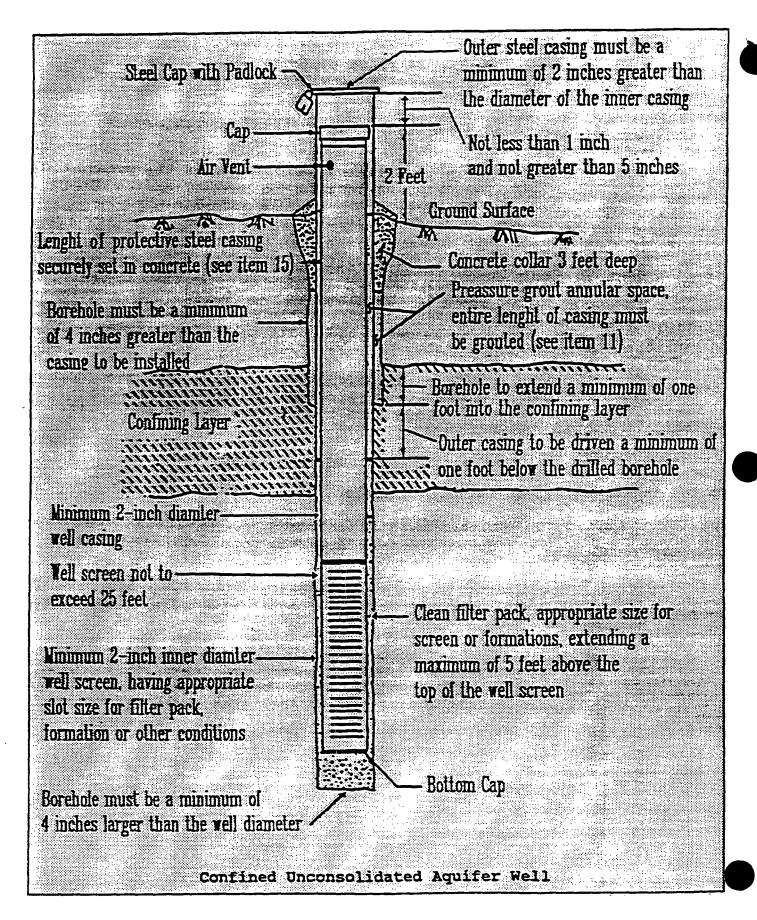
- c. When grouting the annular space directly above a filter pack, the grout should be discharged horizontally from the tremie pipe.
- 13. Potable water must be used for mixing grouting materials and drilling fluids.
- 14. The driller must maintain an accurate written log of all materials encountered, record construction details for each well, and record the depth of each water bearing zone. This information must be submitted to the Bureau of Water Allocation as required by N.J.S.A. 58:4A-14.
- 15. The protective steel casing shall be installed to a minimum depth of 3 feet below grade, equipped with a locking cap and securely set in concrete, as shown in the diagram. The locking cap must be made of steel. Flush-mount monitoring wells are acceptable provided they have manholes, locking caps, and seals to prevent leakage of surface water into the well.
- 16. Top of the innermost casing (excluding cap) must be surveyed to the nearest 0.01 foot by a New Jersey licensed surveyor. The survey point shall be the highest point of the casing. The survey point must be marked on each well.
- 17. Wells should be developed to a turbid-free discharge.

Notice is Hereby Given of the Following:

The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable, or other structures.

The permittee (applicant) is solely responsible for the safety and adequacy of the design and construction of monitoring well(s) required by the Department.

The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.



Ground Water Sampling with the use of a HydroPunch $^{\rm R}$ Direct Push Sampler (3/94) Title:

Method Number: AGWST 6.00

Summary:

The HydroPunch is a sampling tool constructed of stainless steel and teflon used for collecting ground water samples. This document provides guidance for the use of this tool in ground water investigations.

PURPOSE AND SCOPE Ι

This document summarizes the minimum requirements for the use of the HydroPunch (HP-I and HP-II) for the collection of ground water data for site investigations.

ΙI METHOD_OVERVIEW

Α. Tool

- The HydroPunch^R I (HP-I) sampling tool collects the sample in only one mode, within the sample chamber (Figure I). This tool collects ground water through the effect of in-situ hydrostatic head, therefore, the top of the sample chamber must be 1. below the ground water table for sample acquisition. A sample cannot be collected across the ground water table with the HP-I. The HP-I is designed to be used by cone penetrometer or drill rig.
- The HydroPunch^R II (HP-II) sampling tool can be 2. operated in two modes, hydrocarbon and water sampling (Figure II). The water sampling mode is similar in operation to the HP-I. In the hydrocarbon mode a PVC screen is exposed so samples can be collected across the ground water table of an unconfined aquifer to determine the presence of floating product. The HP-II was specifically designed to be used by drilling contractors. It larger diameter limits the effective depth when pushed from the surface with cone penetrometer rigs.

в. Applications

- 1. Collection of ground water samples for the determination of the presence/absence and extent of ground water contamination.
- 2. Field screening tool to aid in the placement of monitor wells.

3. Temporary placement for the collection of ground water samples and estimating ground water flow directions (less than 48 hours).

C. Capabilities

- 1. Obtain ground water samples from unconfined aguifers.
- 2. Obtain ground water samples from confined aquifers provided the upper aquifer is cased off and the casing is driven a minimum of two feet into the confining layer.
- 3. Obtain samples across the water table to determine the presence of floating product (HP-II).
- 4. Capable of collecting samples to determine the vertical profiling of contaminants in an aquifer.
- 5. Ability to collect ground water samples from small discrete water bearing zones. (HP-I & HP-II)
- 6. Capable of being used with a cone penetrometer rig or a conventional drill rig.
- 7. A comparison of the advantages and limitations for both the HP-1 and HP-II are listed in Table I.

III SAMPLING METHOD REQUIREMENTS

A. Installation

- 1. The HydroPunch^R is capable of use in unconsolidated formations only. When being installed, the drilling must stop above the target sample depth thereby not disturbing the zone to be sampled. It is therefore imperative to have some idea of the depth at which the sample will be collected. If little is known of the site geology, then an initial boring should be made to determine 1) depth of water bearing zones 2) permeability of sample zone 3) density of soil 4) identify the subsurface stratigraphy 5) other pertinent data for the investigation.
- When used with a conventional drill rig the hole must be advanced (with hollow stem augers, mud rotary etc.) to the depth which is above the zone of interest, eliminating any interference from the drilling. The HydroPunch^R may then be driven to the desired sampling interval for sample collection.

- 3. <u>DO NOT</u> set the HydroPunch^R down on the bottom of the borehole and pick it up. This will open the tool and compromise the sample integrity. Damage to the tool may be incurred if it is driven after being opened. Also, caution must be taken <u>not</u> to back hammer when driving the HydroPunch^R for the above stated reason.
- 4. Always accurately measure the distance the tool is pushed or driven and the distance pulled back.
- 5. Never pull the HydroPunch^R back farther than it is pushed or driven into the undisturbed soil. This may result in cross contamination of the sample from other zones in the borehole, or loss of the casing (in the hydrocarbon mode) resulting in the inability for sample collection.
- 4. Installation of the tool is required to comply with all permit, license, sealing and grouting requirements as per Appendices I and II. Any tool left in the ground longer than 48 hours is considered a monitor well and therefore must comply the permit, installation and license requirements for monitor wells.

B. Sampling Procedures

- 1. Hydrocarbon Mode (HP-II)
 - a. The hydrocarbon mode is used to collect ground water samples when:
 - o A sample must be obtained from the water table interface of an unconfined aquifer.
 - o A large volume of sample is required.
 - o The presence of floating product is suspected.
 - b. A sacrificial 0.010-inch PVC screen
 (approx. 5') is attached to a disposable drive
 cone. The screen and drive cone are then
 inserted into the body of the HP-II until the
 O-Ring on the cone is sealed in drive shoe.
 Place the sleeve over the juncture of the
 drive cone and body of the unit.
 - of the unit is pulled back exposing the screen. Friction with the seal will hold the

cone in position while the screen is exposed. Do not pull back a distance greater than the length of the screen.

- d. The EW, BW, or NW casing used to drive the tool allows for the placement of a small diameter bailer (3/4" or 1") to be lowered down through the casing and body of the HP-II and into the screen for sample collection.
- e. The Hydropunch does <u>not</u> have to be purged or developed prior to sampling.
- 2. Water Sampling Mode (HP-1 and HP-II)
 - a. The HP-II in the ground water sampling mode or HP-I can be used when samples are required at a minimum of five (5) feet below the top of the water table and when a small sample volume (500 ml-1,200 ml dependent upon tool) is adequate.
 - b. Place the lower check valve with attached filter screen into the bottom of the tool body and place the upper check valve in the top of the tool. Insert the disposable drive cone into the drive shoe ensuring a seal is made by the O-Ring. Place sleeve over the juncture of the drive cone and drive shoe.
 - c. Push or drive (with 140 lb hammer, 30 inch travel) the unit to the desired depth and pull back approximately two (2) feet. Soil friction will hold the drive cone in place.
 - d. Ground water flows into the intake screen past the lower check valve, into the sample chamber and finally out the top check valve.
 - e. When full the tool is pulled to the surface, increasing the hydrostatic head within the tool closing the two check valves.
 - f. At the surface the HP-II is inverted and the sample is decanted through a discharge valve and tubing into the sample containers.
- C. Quality Assurance/Quality Control
 - 1. Decontamination

The HydroPunch^R, drill rods and drive casing must be decontaminated between samples using the following procedure:

- a) Disassemble the HydroPunch^R unit and remove O-Rings. The PVC screen is disposable and must be discarded.
- b) Scrub with a laboratory grade glassware detergent.
- c) Rinse with potable water and/or steam clean.
- d) Rinse entire unit with distilled and deionized ASTM Type II water.
- e) Replace O-Rings.
- f) Reassemble unit.
- g) The PVC screen is supplied by the manufacturer already cleaned. If the packaging is compromised then it should be cleaned in the same manner as the HydroPunch and casing.

2. Field Blanks

Field blanks must be obtained in the same manner as samples (i.e., if hydrocarbon mode is used blank water must pass through bailer, screen and $HydroPunch^R$ body).

Parameters and frequency for field blanks are designated in the May 1992 edition of the NJDEPE Field Sampling Procedures Manual (FSPM).

3. Sample Equipment

The NJDEPE Field Sampling Procedures Manual can be used as a reference for the selection of sampling equipment and procedures for use with the HP-II in the hydrocarbon mode. The HydroPunch in the water sampling mode is in itself a sampler.

All sampling equipment must be decontaminated in accordance with the NJDEPE Field Sampling Procedures Manual and dedicated to each sample point.

4. Rod Sealing

When using the HydroPunch^R in the hydrocarbon or ground water mode for obtaining samples deep in the unconfined aquifer or in a confined aquifer, or using the unit with hollow stem augers on mud rotary drilling, the drill rod/casing joints must be sealed. This will prevent fluid from entering the rods and potentially contaminating the sample.

The rods should be sealed with Teflon^R tape on the threads. Once put together the joints must be sealed with gas pipe tape. Another option is the use of drill rod with O-Rings at the threads for sealing.

5. Formation Types

The HydroPunch^R can be installed in unconsolidated materials. Varying amounts of pebbles, cobbles and boulders may impede advancement or damage the tool.

IV REFERENCES

- 1. Cordry, Kent; "Hydropunch R User's Guide
- Cordry, Kent; "Technical Information and Application Guidelines - Hydropunch"
- 3. Bergen, C.L.; Tuckfield, R.C.; Park, NM; "Suitability of the Hydropunch for Assessing Ground Water Contaminated by Volatile Organics
- 4. Cordry, Kent; HydroPunch II The Second Generation.
 New In Situ Ground Water Sampling Tool. In Procedures of the Fifth National Outdoor Action Conference on Aquifer Restoration Ground Water Monitoring, and Geophysical Methods. pp 715-723 May 13-16, 1991, Las Vegas, Nevada.
- 5. Strutynsky, A.I.; Sainey, T.J.; Use of Piezometeric Cone Penetration Testing and Penetrometer Ground Water Sampling for Volatile Organic Contaminant Plume Detection. In Procedures of the Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. p70-84. October 1990, Houston, TX.
- 6. Edge, R; Cordry, K; The HydroPunch: An In Situ Sampling Tool for Collecting Ground Water from Unconsolidated Sediments. Ground Water Monitoring Review, Vol. IX (3) pp 177-183, 1989.
- 7. Smolley, M: Kappmeyer, J; Cone Penetrometer Tests and HydroPunch Sampling: A Screening Technique for Plume Definition. Ground Water Monitoring Review, Vol XI, No. 3, pp 101-106.
- 8. Van Sciver, C., Wallace, E.; The Evaluation of the HydroPunch II to Obtain a Representative Ground Water Sample. 9th Annual Waste Testing and Quality Assurance Symposium; July 12-16, 1993, Arlington, VA

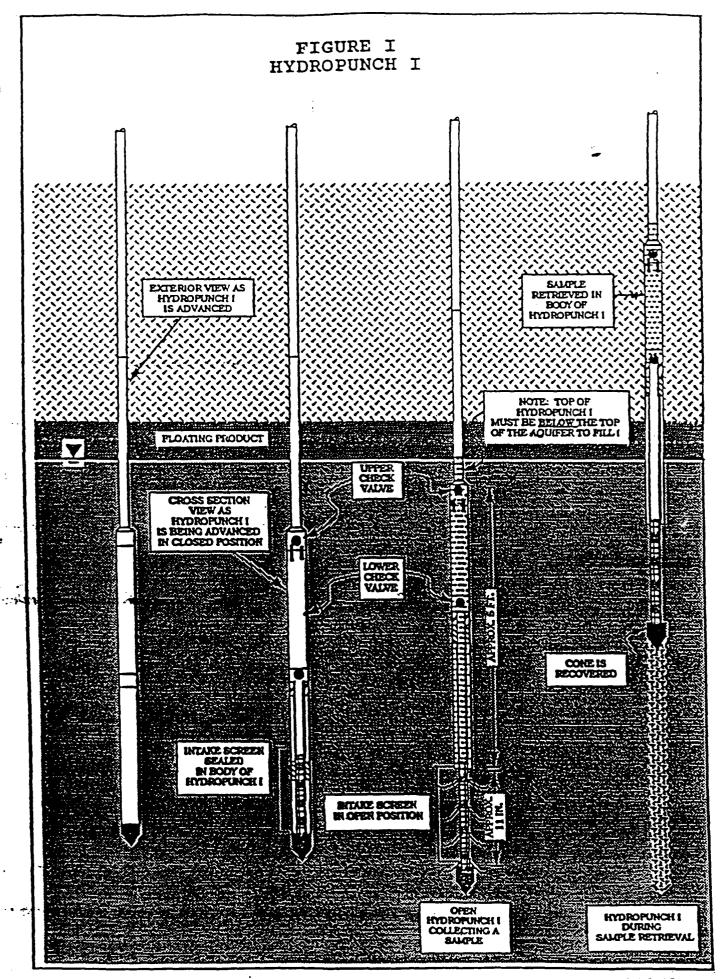
TABLE I

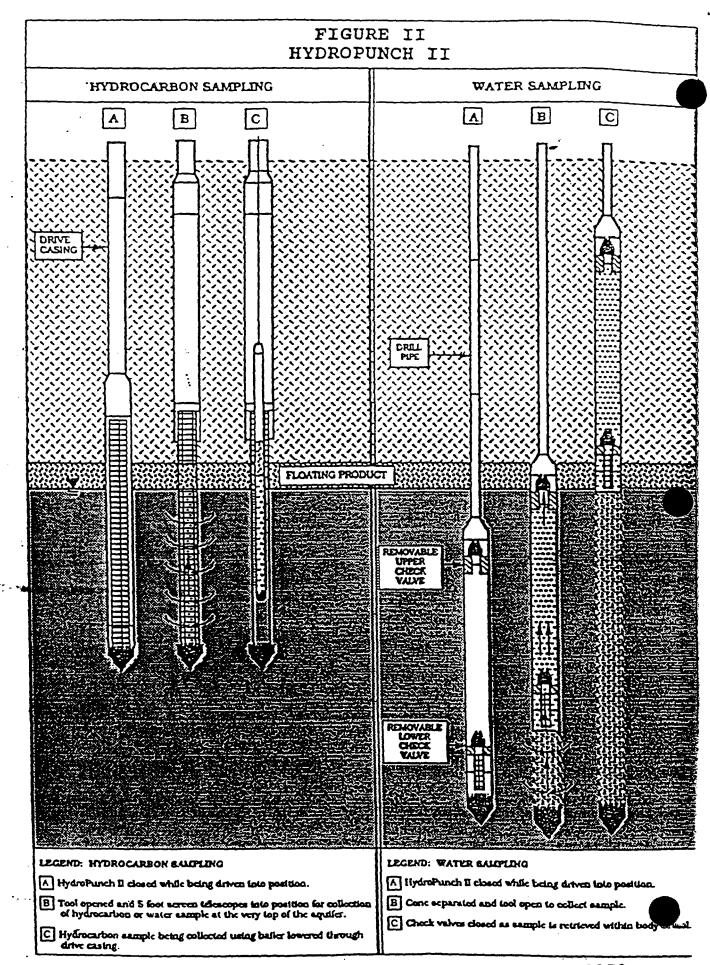
ADVANTAGES AND LIMITATIONS COMPARISON OF HP-I AND HP-II

	HP-I	HP-II
ADVANTAGES	 Small diameter - can be used with cone penetrometer rig. 	General: 1. Simpler design and fewer parts for fast decontamination.
***:	 Reusable cone. Vertical profiling from a single borehole without concern about drilling through disposable cones and screens. 	2. No moving parts are attached permanently to the tool making it more durable and reliable. 3. Removable check valves providing 2 sample modes which increases flexibility. Hydrocarbon Mode: 1. Can collect sample at top of aquifer, including product. 2. Can collect an unlimited volume of sample. 3. Can collect sample from thin aquifer. 4. Can directly measure fill rate. Ground Water Mode: 1. Tool does not have to be driven on special casing. 2. Only tool needs to be decontaminated. 3. Tool can be driven using downhole wireline hammers.

Table I contd.

1. Thin diameter and sliding parts with close tolerances make tool susceptible to damage when driven by drilling rig. 2. Short intake interval (11-inch) makes sampling from thin water bearing zones difficult. 3. The intake screen must be at least 5 feet below the top of the aquifer to collect a complete sample. 4. Sample volume is limited to approximately 500 ml. 5. Yields a turbid sample intervals in low aquifers may cause degeneration of sample integrity. 7. Requires drill rig for installation. Hydrocarbon Mode: 1. Hollow drive pipe must extend to surface. 2. Drive pipe must be decontaminated. 3. A cone and screen is lost each time the tool is used. 4. The rate and amount of sample obtained is dependent upon the permeability of the formation. 5 Yields a turbid sample therefore samples for various analytes may be biased high. 6. Long sample acquisition times in low yielding aquifers may cause degeneration of sample therefore samples for various analytes may be biased high. 5. Long sample acquisition times in low yielding aquifers may cause degeneration of sample integrity. 6. Requires drill rig for installation. 7. Formations with 20-30% silts and clays may not yield		Г	T
sliding parts with close tolerances make tool susceptible to damage when driven by drilling rig. 2. Short intake interval (11-inch) makes sampling from thin water bearing zones difficult. 3. The intake screen must be at least 5 feet below the top of the aquifer to collect a complete sample. 4. Sample volume is limited to approximately 500 ml. 5. Yields a turbid sample acquisition times in low aquifers may cause degeneration of sample integrity. 7. Requires drill rig for installation. Sample volume is limited to approximately 500 ml. 5. Yields a turbid sample integrity. 7. Requires drill rig for installation. Ground Water Mode: 1. Hollow drive pipe must extend to surface. 2. Drive pipe must be edecontaminated. 3. A cone and screen is lost each time the tool is used. 4. The rate and amount of sample obtained is dependent upon the permeability of the formation. 5. Yields a turbid sample therefore sample acquisition times in low yielding aquifers may cause degeneration of sample integrity. 6. Sample time intervals in low aquifers may cause degeneration of sample integrity. 7. Requires drill rig for installation. 6. Long sample acquisition times in low yielding aquifers may cause degeneration of sample integrity. 7. Requires drill rig for installation. 8. A cone and screen is lost each time the tool is used. 9. The rate and amount of sample therefore sample acquisition times in low yielding aquifers may be biased high. 5. Direct monitoring of the tool fill rate is difficult. 9. Direct monitoring of the tool fill rate is difficult. 9. Direct monitoring of the aquifer to obtain a full sample. 1. Hollow drive pipe must be decontaminated. 1. Hollow drive pipe must be decontaminated. 1. The rate and amount of sample therefore samples for various analytes may be biased high. 5. Long sample acquisition times in low yielding aquifers may cause degeneration of sample integrity. 9. Pequires drill rig for installation. 1. Hollow drive pipe must extend to surbid each time the tool of time tool of mu		HP-I	HP-II
sufficient water for sampling and limit use of the tool.	LIMITATIONS	sliding parts with close tolerances make tool susceptible to damage when driven by drilling rig. 2. Short intake interval (11-inch) makes sampling from thin water bearing zones difficult. 3. The intake screen must be at least 5 feet below the top of the aquifer to collect a complete sample. 4. Sample volume is limited to approximately 500 ml. 5. Yields a turbid sample. 6. Sample time intervals in low aquifers may cause degeneration of sample integrity. 7. Requires drill rig	1. Hollow drive pipe must extend to surface. 2. Drive pipe must be decontaminated. 3. A cone and screen is lost each time the tool is used. 4. The rate and amount of sample obtained is dependent upon the permeability of the formation. 5. Yields a turbid sample therefore samples for various analytes may be biased high. 6. Long sample acquisition times in low yielding aquifers may cause degeneration of sample integrity. 7. Requires drill rig for installation. Ground Water Mode: 1. The intake must be at least 5 feet below the top of the aquifer to obtain a full sample. 2. Direct monitoring of the tool fill rate is difficult. 3. Sample volume is limited to 1.2 liters. 4. Yields a turbid sample therefore samples for various analytes may be biased high. 5. Long sample acquisition times in low yielding aquifers may cause degeneration of sample integrity. 6. Requires drill rig for installation. 7. Formations with 20-30% silts and clays may not yield sufficient water for sampling and limit use of





ATTACHMENT D

USEPA REGION II GROUNDWATER SAMPLING PROCEDURE

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION II

GROUNDWATER SAMPLING PROCEDURE LOW STRESS PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting groundwater samples from monitoring wells. The procedure minimizes stress on the formation and minimizes disturbance of sediment in the well. The procedure applies to monitoring wells that have well casing with an inner diameter of 2.0 inch or greater. It is appropriate for groundwater samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with any EPA program.

This procedure does not address the collection of non-aqueous phase liquid (NAPL) samples and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site
Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water
Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The goal of the Low Stress Purging and Sampling procedure is to collect samples that are representative of groundwater conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that allows a maximum drawdown of 0.3 foot.

Sampling at such a low flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing a filtered sample from the same well. Second, it minimizes aeration of the groundwater during sample collection, which improves the sample quality for VOC analysis. Third, in most cases it significantly reduces the volume of groundwater purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of a key indicator parameter to stabilize; c) cascading of water and formation of air bubbles in the tubing; and d) cross-contamination.

Insufficient Yield

For wells with insufficient yield (i.e., low recharge rate of the well), care should be taken to avoid loss of pressure in the tubing line, cascading through the sand pack, or pumping the well dry. Purging should be interrupted before the water level in the well drops below the top of the pump. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If a key indicator parameter fails to stabilize after 4 hours, one of three options should be considered; a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; or c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book. The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

For cascading and air bubbles in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with liquid during sampling.

Cross-Contamination

To reduce problems associated with cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more extensive daily decontamination procedures between sampling of each well as well as at the start of each sampling day (see Section VII, below).

IV. EQUIPMENT

Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify, for each well, the depth to which the pump intake should be lowered. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist.

- Well construction data, location map, field data from last sampling event.
- Polyethylene sheeting.
- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).
- Adjustable rate, positive displacement groundwater sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may be used only for inorganic sample collection.
- Interface probe or equivalent device for determining the presence or absence of NAPL.
- reflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.
- Water level measuring device, 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).
 - Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).
 - Power source (generator, nitrogen tank, etc.).
 - Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. pH, specific conductance, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.
 - Decontamination supplies (see Section VII, below).
 - Logbook (see Section VIII, below).
 - Sample bottles.
 - Sample preservation supplies (as required by the analytical methods).
 - Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water.

- Check well for damage or evidence of tampering. Record observations.
- 2. Lay out sheet of polyethylene for monitoring and sampling equipment.
- 3. Measure VOCs at the rim of the unopened well with a PID or FID instrument and record the reading in the field log book.
- 4. Remove well cap.
- 5. Measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field log book.
- 6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one.
- 7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled before any purging begins. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.
- 8. If desired, measure and record the depth of any DNAPLs or LNAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the groundwater.

Sampling Procedures

- 9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or otherwise approved by the EPA hydrogeologist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.
- 10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.
- 11. Purge Well: Start pumping the well at 200 to 500

milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of •0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

±0.1 for pH
±3% for specific conductance (conductivity)
±10 mv for redox potential
±10% for DO and turbidity

Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at flow rates of between 100 and 250 ml/min or such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. Samples should be collected at the same flow rate at which the indicator parameters stabilized. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.

Some groundwater samples require pH adjustment. The appropriate EPA Program Guidance (e.g., Region II CERCLA QA Manual) should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 mls). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for

re-sampling by hanging the tubing inside the well.

- 15. Measure and record well depth.
- 16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Equipment blank (not necessary if equipment is dedicated to the well)
- ► Trip blanks for VOCs only

As noted above, groundwater samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, must be decontaminated thoroughly each day before use (daily decon) and after each well is sampled (between-well decon). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using daily decon procedures (see #18, below) prior to their initial use. centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use (daily decon). EPAs field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled (between-well decon, see #17 below).

17. Daily Decon

- A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.
- C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- D) Disassemble pump.
- E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.
- F) Rinse pump parts with potable water.
- G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.
- H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO3).
- I) Rinse impeller assembly with potable water.
- J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.
- K) Rinse impeller assembly with distilled/deionized water.

18. Between-Well Decon

- A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.
- C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
 - Static water level depth, date, time, and measurement technique.
 - Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
 - Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
 - Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- ► Name of sample collector(s).
- Weather conditions.
 - QA/QC data for field instruments.

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, EPA/540/S-95/504.

U.S. EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

ATTACHMENT E

USEPA ERT STANDARD OPERATING PROCEDURES



SUMMA CANISTER SAMPLING

SOP#: 1704 DATE: 07/27/95

REV. #: 0.1

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe a procedure for sampling of volatile organic compounds (VOCs) in ambient air. The method is based on samples collected as whole air samples in Summa passivated stainless steel canisters. The VOCs are subsequently separated by gas chromatography (GC) and measured by mass-selective detector or multidetector techniques. This method presents procedures for sampling into canisters at final pressures both above and below atmospheric pressure (respectively referred to as pressurized and subatmospheric pressure sampling).

This method is applicable to specific VOCs that have been tested and determined to be stable when stored in pressurized and subatmospheric pressure canisters. The organic compounds that have been successfully collected in pressurized canisters by this method are listed in the Volatile Organic Compound Data Sheet (Appendix A). These compounds have been measured at the parts per billion by volume (ppbv) level.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure or other procedure limitations. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Both subatmospheric pressure and pressurized sampling modes use an initially evacuated canister. Both modes may also use a mass flow controller/vacuum pump arrangement to regulate flow. With the above configuration, a sample of ambient air

is drawn through a sampling train comprised of components that regulate the rate and duration of sampling into a pre-evacuated Summa passivated canister. Alternatively, subatmospheric pressure sampling may be performed using a fixed orifice, capillary, or adjustable micrometering valve in lieu of the mass flow controller/vacuum pump arrangement for taking grab samples or short duration time-integrated samples. Usually, the alternative types of flow controllers are appropriate only in situations where screening samples are taken to assess for future sampling activities.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

After the air sample is collected, the canister valve is closed, an identification tag is attached to the canister, and the canister is transported to a laboratory for analysis. Upon receipt at the laboratory, the canister tag data is recorded. Sample holding times and expiration should be determined prior to initiating field activities.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Contamination may occur in the sampling system if canisters are not properly cleaned before use. Additionally, all other sampling equipment (e.g., pump and flow controllers) should be thoroughly cleaned.

5.0 EQUIPMENT/APPARATUS

The following equipment/apparatus (Figure 1, Appendix B) is required:

5.1 Subatmospheric Pressure Sampling Equipment

- 1. VOC canister sampler whole air sampler capable of filling an initially evacuated canister by action of the flow controlled pump from vacuum to near atmospheric pressure. (Andersen Samplers Inc., Model 87-100 or equivalent).
- 2. Sampling inlet line stainless steel tubing to connect the sampler to the sample inlet.
- 3. Sample canister leak-free stainless steel pressure vessels of desired volume with valve and Summa passivated interior surfaces (Scientific Instrumentation Specialist, Inc., ID 83843, Andersen Samplers, Inc., or equivalent).
- 4. Particulate matter filter 2-μm sintered stainless steel in-line filter (Nupro Co., Model SS-2F-K4-2, or equivalent).
- 5. Chromatographic grade stainless steel tubing and fittings for interconnections (Alltech Associates, Cat. #8125, or equivalent). All materials in contact with sample, analyte, and support gases should be chromatographic grade stainless steel.
- 6. Fixed orifice, capillary, or adjustable micrometering valve used in lieu of the electronic flow controller/vacuum pump for grab samples or short duration time-integrated samples.

5.2 Pressurized Sampling Equipment

- 1. VOC canister sampler whole air sampler capable of filling an initially evacuated canister by action of the flow controlled pump from vacuum to near atmospheric pressure. (Andersen Samplers Inc., Model 87-100).
- 2. Sampling inlet line stainless steel tubing to connect the sampler to the sample inlet.
- 3. Sample canister leak-free stainless steel pressure vessels of desired volume with valve and Summa passivated interior

- surfaces (Scientific Instrumentation Specialist, Inc., ID 83843, Andersen Samplers, Inc., or equivalent).
- 4. Particulate matter filter 2-μm sintered stainless steel in-line filter (Nupro Co., Model SS-2F-K4-2, or equivalent).
- 5. Chromatographic grade stainless steel tubing and fittings for interconnections (Alltech Associates, Cat. #8125, or equivalent). All materials in contact with sample, analyte, and support gases should be chromatographic grade stainless steel.

6.0 REAGENTS

This section is not applicable to this SOP.

7.0 PROCEDURE

7.1 Subatmospheric Pressure Sampling

- 7.1.1 Sampling Using a Fixed Orifice, Capillary, or Adjustable Micrometering Valve
- 1. Prior to sample collection, the appropriate information is completed on the Canister Sampling Field Data Sheet (Appendix C).
- 2. A canister, which is evacuated to 0.05 mm Hg and fitted with a flow restricting device, is opened to the atmosphere containing the VOCs to be sampled.
- 3. The pressure differential causes the sample to flow into the canister.
- 4. This technique may be used to collect grab samples (duration of 10 to 30 seconds) or time-integrated samples (duration of 12 to 24 hours). The sampling duration depends on the degree to which the flow is restricted.
- 5. A critical orifice flow restrictor will have a decrease in the flow rate as the pressure approaches atmospheric.
- 6. Upon sample completion at the location, the appropriate information is recorded on the

Canister Sampling Field Data Sheet.

- 7.1.2 Sampling Using a Mass Flow Controller/Vacuum Pump Arrangement (Andersen Sampler Model 87-100)
- 1. Prior to sample collection the appropriate information is completed on the Canister Sampling Field Data Sheet (Appendix C).
- A canister, which is evacuated to 0.05 mm
 Hg and connected in line with the sampler, is
 opened to the atmosphere containing the
 VOCs to be sampled.
- A whole air sample is drawn into the system through a stainless steel inlet tube by a direct drive blower motor assembly.
- A small portion of this whole air sample is pulled from the inlet tube by a specially modified inert vacuum pump in conjunction with a mass flow controller.
- 5. The initially evacuated canister is filled by action of the flow controlled pump to near atmospheric pressure.
- 6. A digital time-program is used to pre-select sample duration and start and stop times.
- 7. Upon sample completion at the location, the appropriate information is recorded on the Canister Sampling Field Data Sheet.

7.2 Pressurized Sampling

- 7.2.1 Sampling Using a Mass Flow Controller/Vacuum Pump Arrangement (Anderson Sampler Model 87-100)
- 1. Prior to sample commencement at the location, the appropriate information is completed on the Canister Sampling Field Data Sheet.
- 2. A canister, which is evacuated to 0.05 mm Hg and connected in line with the sampler, is opened to the atmosphere containing the

VOCs to be sampled.

- A whole air sample is drawn into the system through a stainless steel inlet tube by a direct drive blower motor assembly.
- 4. A small portion of this whole air sample is pulled from the inlet tube by a specially modified inert vacuum pump in conjunction with a mass flow controller.
- 5. The initially evacuated canister is filled by action of the flow controlled pump to a positive pressure not to exceed 25 psig.
- A digital time-programmer is used to pre-select sample duration and start and stop times.
- 7. Upon sample completion at the location, the appropriate information is recorded on the Canister Sampling Field Data Sheet.

8.0 CALCULATIONS

1. A flow control device is chosen to maintain a constant flow into the canister over the desired sample period. This flow rate is determined so the canister is filled to about 88.1 kPa for subatmospheric pressure sampling or to about one atmosphere above ambient pressure for pressurized sampling over the desired sample period. The flow rate can be calculated by:

$$F = \frac{(P)(V)}{(T)(60)}$$

where:

F = flow rate (cm³/min)
P = final canister pressure,
atmospheres absolute
V = volume of the canister
(cm³)
T = sample period (hours)

For example, if a 6-L canister is to be filled to 202 kPa (two atmospheres) absolute pressure in 24 hours, the flow rate can be calculated by:

$$F = \frac{(2)(6000)}{(24)(60)} = 8.3cm^3/\min$$

 If the canister pressure is increased, a dilution factor (DF) is calculated and recorded on the sampling data sheet.

$$DF = \frac{Ya}{Xa}$$

where:

Xa = canister pressure (kPa, psia) absolute before dilution.

Ya = canister pressure (kPa, psia) absolute after dilution.

After sample analysis, detected VOC concentrations are multiplied by the dilution factor to determine concentration in the sampled air.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

The following general quality assurance procedures apply:

- 1. All data must be documented on standard chain of custody records, field data sheets, or site logbooks.
- 2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety practices. Specifically, pressurizing of Summa canisters should be performed in a well ventilated room, or preferably under a fume hood. Care must be taken not to exceed 40 psi in the canisters. Canisters are under pressure, albeit only 20-30 psi, and should not be dented or punctured. They should be stored in a cool dry place and always be placed in their plastic shipping boxes during transport and storage.

12.0 REFERENCES

- Ralph M. Riggin, Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Ambient Air, EPA-600/4-83-027 U. S. Environmental Protection Agency, Research Triangle Park, NC, 1983.
- W. A. McClenny, J. D. Pleil, T. A. Lumpkin and K. D. Oliver, "Update on Canister-Based Samplers for VOCs," Proceedings of the 1987 EPA/APCA Symposium on Measurement of Toxic and Related Air Pollutants, May, 1987 APCA Publication VIP-8, EPA 600/9-87-010.
- 3. J. F. Walling, "The Utility of Distributed Air Volume Sets When Sampling Ambient Air Using Solid Adsorbents," Atmospheric Environ., 18:855-859, 1984.
- J. F. Walling, J. E. Bumgarner, J. D. Driscoll, C. M. Morris, A. E. Riley, and L. H. Wright, "Apparent Reaction Products Desorbed From Tenax Used to Sample Ambient Air," Atmospheric Environ., 20:51-57, 1986.
- Portable Instruments User's Manual for Monitoring VOC Sources, EPA-340/1-88-015, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, D.C., June 1986.

- 6. R. A. Rasmussen and J. E. Lovelock, Atmospheric Measurements Using Canister Technology, J. Geophys. Res., 83: 8369-8378, 1983.
- 7. R. A. Rasmussen and M. A. K. Khalil, "Atmospheric Halocarbon: Measurements and Analysis of Selected Trace Gases," Proc. NATO ASI on Atmospheric Ozone, BO: 209-231.
- 8. EPA Method TO-14 "Determination of Volatile Organic Compounds (VOC's) in Ambient Air Using Summa Passivated Canister Sampling and Gas Chromatographic Analysis", May 1988.

APPENDIX A

Volatile Organic Compound Data Sheet

TABLE 1. VOLATILE ORGANIC COMPOUND DATA SHEET

COMPOUND (SYNONYM)	FORMULA	MOLECULAR WEIGHT	BOTLING POINT (°C)	MELTING POINT (°C)	CAS NUMBER
		120.91	-29.8	-158.0	
Freon 12 (Dichlorodifluoromethane)	Clacks	50.49	-24.2	-136.u -97.1	74-87-3
Methyl chloride (Chloromethane)	CH3C1	170.93	4.1	-94.0	/4-0/-3
Freon 114 (1,2-Dichloro-1,1,2,2-	CICF2CCIF2	1/0.93	7.1	-94.0	1
tetrafluoroethane)		62.50	-13.4	-1538.0	75-01-4
Vinyl chloride (Chloroethylene)	CH2=CHC1	94.94	3.6	-1336.0	74-83-9
Methyl bromide (Bromomethane)	CH3Br	64.52	12.3	-136.4	75-00-3
Ethyl chloride (Chloroethane)	CH3CH2C1		23.7	-111.0	/5-00-3
Freon 11 (Trichlorofluoromethane)	CC13F	137.38	31.7	-111.0	75-35-4
Vinylidene chloride (1,1-Dichloroethene)	C2H2C12	96.95	31.,		
Dichloromethane (Methylene chloride)	CH2C12	84.94	39.8	-95.1	75-09-2
Freon 113 (1,1,2-Trichloro-1,2,2- trifluoroethane)	CF2CICCI2F	187.38	47.7	-36.4	ļ
1.1-Dichloroethame (Ethylideme chloride)	CH3CHC12	98,96	57.3	-97,0	74-34-3
cis-1,2-Dichloroethylene	CHČ 1 = CHČ 1	96.94	60.3	-80,5	1
Chloroform (Trichloromethane)	CHC 13	119.38	61.7	-63.5	67-66-3
1.2-Dichloroethane (Ethylene dichloride)	C1CH2CH2C1	98.96	83.5	-35.3	107-06-2
Methyl chloroform (1,1,1-Trichloroethane)	CH3CČ13	133.41	74.1	-30.4	71-55-6
Benzene (Cyclohexatriene)	C6H6	78.12	80.1	5,5	71-43-2
Carbon tetrachloride ([etrachloromethane)	CČIÁ	153.82	76.5	-23,0	56-23-5
1,2-Dichloropropane (Propylene dichloride)	CH3CHC1CH2C1	112.99	95,4	-100.4	78-87-5
Trichloroethylene (Trichloroethene)	CICH-CCI2	131.29	87	-73.0	79-01-6
cis-1,3-Dichloropropene (cis-1,3-	CH3CC1=CHC1	110.97	76	İ	1
dichioropropylene)			l	L	1
rans-1,3-Dichloropropene (cis-1,3- Dichloropropylene)	CTCH2CH=CHC1	110.97	112.0		}
1.1.2-Trichloroethane (Viny) trichloride)	CH2C1CHC12	133.41	113.8	-36.5	79-00-5
[olumne (Methy) benzene)	CaHaCHa	92.15	110.6	-95.0	108-88-3
[.2-Dibromoethane (Ethylene dibromide)	BrCH2CH2Br	187.88	131.3	9.8	106-93-4
[etrachloroethylene (Perchloroethylene)	ClaC=CCla	165.83	121.1	-19.0	127-18-4
Chlorobenzene (Pheny) chloride)	CAHSC1	112.56	132.0	-45.6	108-90-7
thylbenzene		106.17	136.2	-95.0	100-41-4
	C6H5C2H5	106.17	139.1	-47.9	100-41-4
	1,3-(CH3)2C6H4	106.17	138.3	13.3	
	1,4-(CH3)2C6H4	104.16	145.2	-30.6	100-42-5
Styrene (Vinyl benzene)	C6H5CH=CH2	167.85	146.2	-36.0	79-34-5
1,1,2,2-Tetrachloroethane	CHC ZOHC 12	106.17	144.4	-25.2	19-34-3
	1,2-(CH3)2C6H4		164.7	-44.7	108-67-8
	1,3,5-(CH3)3C6H6		169.3	-43.8	95-63-6
	1,2,4-(CH3)3C6H6	147.01	173.0	-24.7	541-73-1
n-Dichlorobenzene (1,3-Dichlorobenzene)	1,3-C12C6H4	126.59	179.3	-39.0	100-44-7
	C6H5CH2C1	147.01	180.5	-17.0	95-50-1
	1,2-C12C6H4	147.01	174.0	53.1	106-46-7
p-Dichiorobenzene (1,4-Dichiorobenzene)	1,4-C12C6H4 1,2,4-C13C6H3	181.45	213.5	17.0	120-82-1
i,2,4- richiorobenzene dexachlorobutadiene (1,1,2,3,4,4-	1,2,4-1136613	101.73	1 213.3	17.0	*******
Hexachloro-1.3-butadiene)		1	1 1	1	1

APPENDIX B

insulated Enclosure Vacuum/Pressure Gauge Electronic Timer Inlet (-5 ft) Metal Bellows Type Pump For Pressurized Sampling Magnelatch Valve Ground Level Vent -Auxiliary Vacuum Pump Mass Flow **Control Unit** Thermostat $\overline{\circ}$ Canister Heater To AC

FIGURE 1. Subatmospheric/Pressurized Sampling Equipment

APPENDIX C

Canister Sampling Field Data Sheet

Page _	_ of

SUMMA AIR SAMPLING WORK SHEET

Samplers: Date:		Wo	rk Assignment Mana Project Lea	ger:der:	
Sample #					
Location					
SUMMA ID					
Orifice Used					
Analysis/Method					
Time (Start)					
Time (Stop)					
Total Time				-	
SUMMA WENT TO AMBIENT	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO
Pressure Gauge					
Pressure Gauge					
Flow Rate (Pre)					
Flow Rate (Post)					
Flow Rate (Average)					
MET Station On-site? Y General Comments:	/ N				



SAMPLING EQUIPMENT DECONTAMINATION

SOP#: 2006 DATE: 08/11/94

REV. #: 0.0

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide a description of the methods used minimizing, preventing, or cross-contamination of samples due to inappropriate or inadequate equipment decontamination and to provide general guidelines for developing decontamination procedures for sampling equipment to be used during hazardous waste operations as per 29 Code of Federal Regulations (CFR) 1910.120. SOP does not address personne l decontamination.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitation, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Removing or neutralizing contaminants from equipment minimizes the likelihood of sample cross contamination, reduces or eliminates transfer of contaminants to clean areas, and prevents the mixing of incompatible substances.

Gross contamination can be removed by physical decontamination procedures. These abrasive and non-abrasive methods include the use of brushes, air and wet blasting, and high and low pressure water cleaning.

The first step, a soap and water wash, removes all visible particulate matter and residual oils and grease. This may be preceded by a steam or high pressure

water wash to facilitate residuals removal. The second step involves a tap water rinse and a distilled/deionized water rinse to remove the detergent. An acid rinse provides a low pH media for trace metals removal and is included in the decontamination process if metal samples are to be collected. It is followed by an other distilled/deionized water rinse. If sample analysis does not include metals, the acid rinse step can be omitted. Next, a high purity solvent rinse is performed for trace organics removal if organics are a concern at the site. Typical solvents used for removal of organic contaminants include acetone, hexane, or water. Acetone is typically chosen because it is an excellent solvent, miscible in water, and not a target analyte on the Priority Pollutant List. If acetone is known to be a contaminant of concern at a given site or if Target Compound List analysis (which includes acetone) is to be performed, another solvent may be substituted. The solvent must be allowed to evaporate completely and then a final distilled/deionized water rinse is performed. This rinse removes any residual traces of the solvent.

The decontamination procedure described above may be summarized as follows:

- 1. Physical removal
- 2. Non-phosphate detergent wash
- 3. Tap water rinse
- 4. Distilled/deionized water rinse
- 5. 10% nitric acid rinse
- 6. Distilled/deionized water rinse
- 7. Solvent rinse (pesticide grade)
- 8. Air dry
- 9. Distilled/deionized water rinse

If a particular contaminant fraction is not present at the site, the nine (9) step decontamination procedure specified above may be modified for site specificity. For example, the nitric acid rinse may be eliminated if metals are not of concern at a site. Similarly, the solvent rinse may be eliminated if organics are not of concern at a site. Modifications to the standard procedure should be documented in the site specific work plan or subsequent report.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample to be collected and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix being sampled and the parameter(s) of interest.

More specifically, sample collection and analysis of decontamination waste may be required before beginning proper disposal of decontamination liquids and solids generated at a site. This should be determined prior to initiation of site activities.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

- C The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be analyte free (specifically for the contaminants of concern).
- The use of an untreated potable water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal or industrial water treatment system.
- C If acids or solvents are utilized in decontamination they raise health and safety, and waste disposal concerns.
- C Damage can be incurred by acid and solvent washing of complex and sophisticated sampling equipment.

5.0 EQUIPMENT/APPARATUS

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations include the ease of decontaminating or disposing of the equipment. Most equipment and supplies can be easily procured. For example, soft-

bristle scrub brushes or long-handled bottle brushes can be used to remove contaminants. Large galvanized wash tubs, stock tanks, or buckets can hold wash and rinse solutions. Children's wading pools can also be used. Large plastic garbage cans or other similar containers lined with plastic bags can help segregate contaminated equipment. Contaminated liquid can be stored temporarily in metal or plastic cans or drums.

The following standard materials and equipment are recommended for decontamination activities:

5.1 Decontamination Solutions

- C Non-phosphate detergent
- C Selected solvents (acetone, hexane, nitric acid, etc.)
- C Tap water
- C Distilled or deionized water

5.2 Decontamination Tools/Supplies

- C Long and short handled brushes
- C Bottle brushes
- C Drop cloth/plastic sheeting
- C Paper towels
- C Plastic or galvanized tubs or buckets
- C Pressurized sprayers (H₂O)
- C Solvent sprayers
- C Aluminum foil

5.3 Health and Safety Equipment

Appropriate personal protective equipment (i.e., safety glasses or splash shield, appropriate gloves, aprons or coveralls, respirator, emergency eye wash)

5.4 Waste Disposal

- C Trash bags
- C Trash containers
- C 55-gallon drums
- C Metal/plastic buckets/containers for storage and disposal of decontamination solutions

6.0 REAGENTS

There are no reagents used in this procedure aside from the actual decontamination solutions. Table 1 (Appendix A) lists solvent rinses which may be required for elimination of particular chemicals. In

general, the following solvents are typically utilized for decontamination purposes:

- C 10% nitric acid is typically used for inorganic compounds such as metals. An acid rinse may not be required if inorganics are not a contaminant of concern.
- C Acetone (pesticide grade)(1)
- C Hexane (pesticide grade)(1)
- C Methanol⁽¹⁾
- (1) Only if sample is to be analyzed for organics.

7.0 PROCEDURES

As part of the health and safety plan, a decontamination plan should be developed and reviewed. The decontamination line should be set up before any personnel or equipment enter the areas of potential exposure. The equipment decontamination plan should include:

- C The number, location, and layout of decontamination stations.
- C Decontamination equipment needed.
- C Appropriate decontamination methods.
- Methods for disposal of contaminated clothing, equipment, and solutions.
- C Procedures can be established to minimize the potential for contamination. This may include: (1) work practices that minimize contact with potential contaminants; (2) using remote sampling techniques; (3) covering monitoring and sampling equipment with plastic, aluminum foil, or other protective material; (4) watering down dusty areas; (5) avoiding laying down equipment in areas of obvious contamination; and (6) use of disposable sampling equipment.

7.1 Decontamination Methods

All samples and equipment leaving the contaminated area of a site must be decontaminated to remove any contamination that may have adhered to equipment. Various decontamination methods will remove contaminants by: (1) flushing or other physical action, or (2) chemical complexing to inactivate

contaminants by neutralization, chemical reaction, disinfection, or sterilization.

Physical decontamination techniques can be grouped into two categories: abrasive methods and non-abrasive methods, as follows:

7.1.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The mechanical abrasive cleaning methods are most commonly used at hazardous waste sites. The following abrasive methods are available:

Mechanical

Mechanical methods of decontamination include using metal or nylon brushes. The amount and type of contaminants removed will vary with the hardness of bristles, length of time brushed, degree of brush contact, degree of contamination, nature of the surface being cleaned, and degree of contaminant adherence to the surface.

Air Blasting

Air blasting equipment uses compressed air to force abrasive material through a nozzle at high velocities. The distance between nozzle and surface cleaned, air pressure, time of application, and angle at which the abrasive strikes the surface will dictate cleaning efficiency. Disadvantages of this method are the inability to control the amount of material removed and the large amount of waste generated.

Wet Blasting

Wet blast cleaning involves use of a suspended fine abrasive. The abrasive/water mixture is delivered by compressed air to the contaminated area. By using a very fine abrasive, the amount of materials removed can be carefully controlled.

7.1.2 Non-Abrasive Cleaning Methods

Non-abrasive cleaning methods work by forcing the contaminant off a surface with pressure. In general, the equipment surface is not removed using non-abrasive methods.

Low-Pressure Water

.

This method consists of a container which is filled with water. The user pumps air out of the container to create a vacuum. A slender nozzle and hose allow the user to spray in hard-to-reach places.

High-Pressure Water

This method consists of a high-pressure pump, an operator controlled directional nozzle, and a high-pressure hose. Operating pressure usually ranges from 340 to 680 atmospheres (atm) and flow rates usually range from 20 to 140 liters per minute.

<u>Ultra-High-Pressure Water</u>

This system produces a water jet that is pressure d from 1,000 to 4,000 atmospheres. This ultra-high-pressure spray can remove tightly-adhered surface films. The water velocity ranges from 500 meters/second (m/s) (1,000 atm) to 900 m/s (4,000 atm). Additives can be used to enhance the cleaning action.

Rinsing

Contaminants are removed by rinsing through dilution, physical attraction, and solubilization.

Damp Cloth Removal

In some instances, due to sensitive, non-waterproof equipment or due to the unlikelihood of equipment being contaminated, it is not necessary to conduct an extensive decontamination procedure. For example, air sampling pumps hooked on a fence, placed on a drum, or wrapped in plastic bags are not likely to become heavily contaminated. A damp cloth should be used to wipe off contaminants which may have adhered to equipment through airborne contaminants or from surfaces upon which the equipment was set.

Disinfection/Sterilization

Disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization methods are impractical for large equipment. This method of decontamination is typically performed off-site.

7.2 Field Sampling Equipment Decontamination Procedures

The decontamination line is setup so that the first station is used to clean the most contaminated item. It progresses to the last station where the least contaminated item is cleaned. The spread of contaminants is further reduced by separating each decontamination station by a minimum of three (3) feet. Ideally, the contamination should decrease as the equipment progresses from one station to another farther along in the line.

A site is typically divided up into the following boundaries: Hot Zone or Exclusion Zone (EZ), th e Contamination Reduction Zone (CRZ), and the Support or Safe Zone (SZ). The decontamination line should be setup in the Contamination Reduction Corridor (CRC) which is in the CRZ. Figure 1 (Appendix B) shows a typical contaminant reduction zone layout. The CRC controls access into and out of the exclusion zone and confines decontamination activities to a limited area. The CRC boundaries should be conspicuously marked. The far end is the hotline, the boundary between the exclusion zone and the contamination reduction zone. The size of the decontamination corridor depends on the number of stations in the decontamination process, overall dimensions of the work zones, and amount of space available at the site. Whenever possible, it should be a straight line.

Anyone in the CRC should be wearing the level of protection designated for the decontamination crew. Another corridor may be required for the entry and exit of heavy equipment. Sampling and monitoring equipment and sampling supplies are all maintained outside of the CRC. Personnel don their equipment away from the CRC and enter the exclusion zon e through a separate access control point at the hotline. One person (or more) dedicated to decontaminating equipment is recommended.

7.2.1 Decontamination Setup

Starting with the most contaminated station, the decontamination setup should be as follows:

Station 1: Segregate Equipment Drop

Place plastic sheeting on the ground (Figure 2, Appendix B). Size will depend on amount of

equipment to be decontaminated. Provide containers lined with plastic if equipment is to be segregated. Segregation may be required if sensitive equipment or mildly contaminated equipment is used at the same time as equipment which is likely to be heavily contaminated.

Station 2: Physical Removal With A High-Pressure Washer (Optional)

As indicated in 7.1.2, a high-pressure wash may be required for compounds which are difficult to remove by washing with brushes. The elevated temperature of the water from the high-pressure washers is excellent at removing greasy/oily compounds. High pressure washers require water and electricity.

A decontamination pad may be required for the highpressure wash area. An example of a wash pad may consist of an approximately 1 1/2 foot-deep basin lined with plastic sheeting and sloped to a sump at one corner. A layer of sand can be placed over the plastic and the basin is filled with gravel or shell. The sump is also lined with visqueen and a barrel is placed in the hole to prevent collapse. A sump pump is used to remove the water from the sump for transfer into a drum.

Typically heavy machinery is decontaminated at the end of the day unless site sampling requires that the machinery be decontaminated frequently. A separate decontamination pad may be required for heavy equipment.

Station 3: Physical Removal With Brushes And A Wash Basin

Prior to setting up Station 3, place plastic sheeting on the ground to cover areas under Station 3 through Station 10.

Fill a wash basin, a large bucket, or child's swimming pool with non-phosphate detergent and tap water. Several bottle and bristle brushes to physically remove contamination should be dedicated to this station. Approximately 10 - 50 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 4: Water Basin

Fill a wash basin, a large bucket, or child's swimming

pool with tap water. Several bottle and bristle brushes should be dedicated to this station. Approximately 10-50 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 5: Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to contain the water during the rinsing process. Approximately 10-20 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 6: Nitric Acid Sprayers

Fill a spray bottle with 10% nitric acid. An acid rinse may not be required if inorganics are not a contaminant of concern. The amount of acid will depend on the amount of equipment to be decontaminated. Provide a 5-gallon bucket or basin to collect acid during the rinsing process.

Station 7: Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to collect water during the rinsate process.

Station 8: Organic Solvent Sprayers

Fill a spray bottle with an organic solvent. After each solvent rinse, the equipment should be rinsed with distilled/deionized water and air dried. Amount of solvent will depend on the amount of equipment to decontaminate. Provide a 5-gallon bucket or basin to collect the solvent during the rinsing process.

Solvent rinses may not be required unless organics are a contaminant of concern, and may be eliminated from the station sequence.

Station 9: Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to collect water during the rinsate process.

Station 10: Clean Equipment Drop

Lay a clean piece of plastic sheeting over the bottom

plastic layer. This will allow easy removal of the plastic in the event that it becomes dirty. Provide aluminum foil, plastic, or other protective material to wrap clean equipment.

7.2.2 Decontamination Procedures

Station 1: Segregate Equipment Drop

Deposit equipment used on-site (i.e., tools, sampling devices and containers, monitoring instruments radios, clipboards, etc.) on the plastic drop cloth/sheet or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross contamination. Loose leaf sampling data sheets or maps can be placed in plastic zip lock bags if contamination is evident.

Station 2: Physical Removal With A High-Pressure Washer (Optional)

Use high pressure wash on grossly contaminated equipment. Do not use high- pressure wash on sensitive or non-waterproof equipment.

Station 3: Physical Removal With Brushes And A Wash Basin

Scrub equipment with soap and water using bottle and bristle brushes. Only sensitive equipment (i.e., radios, air monitoring and sampling equipment) which is waterproof should be washed. Equipment which is not waterproof should have plastic bags removed and wiped down with a damp cloth. Acids and organic rinses may also ruin sensitive equipment. Consult the manufacturers for recommended decontamination solutions.

Station 4: Equipment Rinse

Wash soap off of equipment with water by immersing the equipment in the water while brushing. Repeat as many times as necessary.

Station 5: Low-Pressure Rinse

Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer.

Station 6: Nitric Acid Sprayers (required only if metals are a contaminant of concern)

Using a spray bottle rinse sampling equipment with nitric acid. Begin spraying (inside and outside) at one end of the equipment allowing the acid to drip to the other end into a 5-gallon bucket. A rinsate blank may be required at this station. Refer to Section 9.

Station 7: Low-Pressure Sprayers

Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer.

Station 8: Organic Solvent Sprayers

Rinse sampling equipment with a solvent. Begin spraying (inside and outside) at one end of the equipment allowing the solvent to drip to the other end into a 5-gallon bucket. Allow the solvent to evaporate from the equipment before going to the next station. A QC rinsate sample may be required at this station.

Station 9: Low-Pressure Sprayers

Rinse sampling equipment with distilled/deionized water with a low-pressure washer.

Station 10: Clean Equipment Drop

Lay clean equipment on plastic sheeting. Once air dried, wrap sampling equipment with aluminum foil, plastic, or other protective material.

7.2.3 Post Decontamination Procedures

- 1. Collect high-pressure pad and heavy equipment decontamination area liquid and waste and store in appropriate drum or container. A sump pump can aid in the collection process. Refer to the Department of Transportation (DOT) requirements for appropriate containers based on the contaminant of concern.
- 2. Collect high-pressure pad and heavy equipment decontamination area solid waste and store in appropriate drum or container. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.
- 3. Empty soap and water liquid wastes from basins and buckets and store in appropriate

drum or container. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.

- 4. Empty acid rinse waste and place in appropriate container or neutralize with a base and place in appropriate drum. pH paper or an equivalent pH test is required for neutralization. Consult DOT requirements for appropriate drum for acid rinse waste.
- Empty solvent rinse sprayer and solvent waste into an appropriate container. Consult DOT requirements for appropriate drum for solvent rinse waste.
- 6. Using low-pressure sprayers, rinse basins, and brushes. Place liquid generated from this process into the wash water rinse container.
- 7. Empty low-pressure sprayer water onto the ground.
- 8. Place all solid waste materials generated from the decontamination area (i.e., gloves and plastic sheeting, etc.) in an approved DOT drum. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.
- 9. Write appropriate labels for waste and make arrangements for disposal. Consult DOT regulations for the appropriate label for each drum generated from the decontamination process.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITYASSURANCE/ QUALITY CONTROL

A rinsate blank is one specific type of quality control sample associated with the field decontamination process. This sample will provide information on the effectiveness of the decontamination process employed in the field.

Rinsate blanks are samples obtained by running analyte free water over decontaminated sampling

equipment to test for residual contamination. The blank water is collected in sample containers for handling, shipment, and analysis. These samples are treated identical to samples collected that day. A rinsate blank is used to assess cross contamination brought about by improper decontamination procedures. Where dedicated sampling equipment is not utilized, collect one rinsate blank per day per type of sampling device samples to meet QA2 and QA 3 objectives.

If sampling equipment requires the use of plastic tubing it should be disposed of as contaminated and replaced with clean tubing before additional sampling occurs.

10.0 DATA VALIDATION

Results of quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow OSHA, U.S. EPA, corporate, and other applicable health and safety procedures.

Decontamination can pose hazards under certain circumstances. Hazardous substances may be incompatible with decontamination materials. For example, the decontamination solution may react with contaminants to produce heat, explosion, or toxic products. Also, vapors from decontamination solutions may pose a direct health hazard to workers by inhalation, contact, fire, or explosion.

The decontamination solutions must be determined to be acceptable before use. Decontamination materials may degrade protective clothing or equipment; some solvents can permeate protective clothing. If decontamination materials do pose a health hazard, measures should be taken to protect personnel or substitutions should be made to eliminate the hazard. The choice of respiratory protection based on contaminants of concern from the site may not be appropriate for solvents used in the decontamination process.

Safety considerations should be addressed when using abrasive and non-abrasive decontamination

equipment. Maximum air pressure produced by abrasive equipment could cause physical injury. Displaced material requires control mechanisms.

Material generated from decontamination activities requires proper handling, storage, and disposal. Personal Protective Equipment may be required for these activities.

Material safety data sheets are required for all decontamination solvents or solutions as required by the Hazard Communication Standard (i.e., acetone, alcohol, and trisodiumphosphate).

In some jurisdictions, phosp hate containing detergents (i.e., TSP) are banned.

12.0 REFERENCES

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, February, 1988.

A Compendium of Superfund Field Operations Methods, EPA 540/p-87/001.

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, USEP A Region IV, April 1, 1986.

Guidelines for the Selection of Chemical Protective Clothing, Volume 1, Third Edition, American Conference of Governmental Industrial Hygienists, Inc., February, 1987.

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, October, 1985.

APPENDIX A

Table

Table 1. Soluble Contaminants and Recommended Solvent Rinse

TABLE 1 Soluble Contaminants and Recommended Solvent Rinse			
SOLVENT ⁽¹⁾	EXAMPLES OF SOLVENTS	SOLUBLE CONTAMINANTS	
Water	Deionized water Tap water	Low-chain hydrocarbons Inorganic compounds Salts Some organic acids and other polar compounds	
Dilute Acids	Nitric acid Acetic acid Boric acid	Basic (caustic) compounds (e.g., amines and hydrazines)	
Dilute Bases	Sodium bicarbonate (e.g., soap detergent)	Acidic compounds Phenol Thiols Some nitro and sulfonic compounds	
Organic Solvents (2)	Alcohols Ethers Ketones Aromatics Straight chain alkalines (e.g., hexane) Common petroleum products (e.g., fuel, oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)	
Organic Solvent ⁽²⁾	Hexane	PCBs	

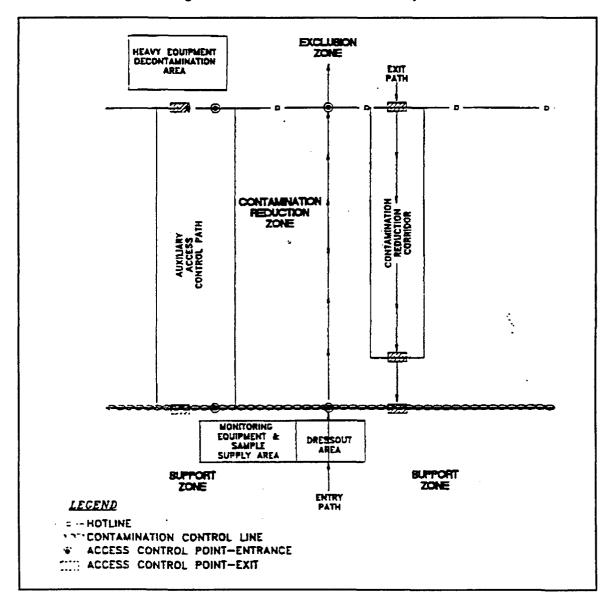
^{(1) -} Material safety data sheets are required for all decontamination solvents or solutions as required by the Hazard Communication Standard

^{(2) -} WARNING: Some organic solvents can permeate and/or degrade the protective clothing

APPENDIX B

Figures

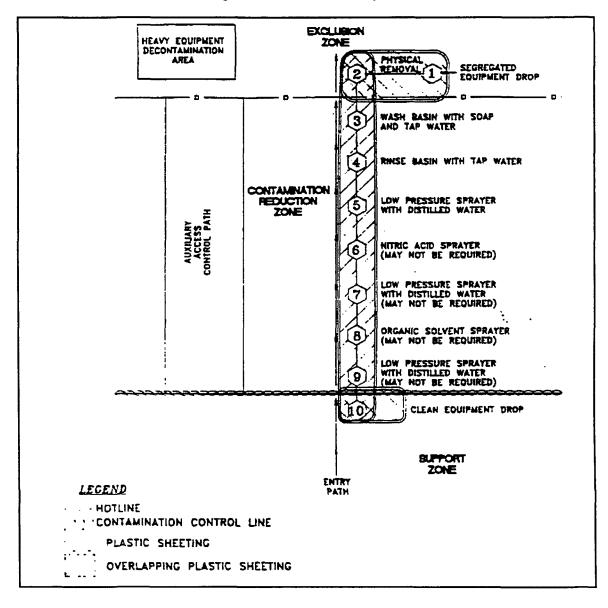
Figure 1. Contamination Reduction Zone Layout



APPENDIX B (Cont'd.)

Figures

Figure 2. Decontamination Layout





SURFACE WATER SAMPLING

SOP#: 2013 DATE: 11/17/94

REV. #: 0.0

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) is applicable to the collection of representative liquid samples, both aqueous and non-aqueous from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure or other procedure limitations. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Sampling situations vary widely, therefore, no universal sampling procedure can be recommended. However, sampling of both aqueous and non-aqueous liquids from the above mentioned sources is generally accomplished through the use of one of the following samplers or techniques:

- C Kemmerer bottle
- C Bacon bomb sampler
- C Dip sampler
- C Direct method

These sampling techniques will allow for the collection of representative samples from the majority of surface waters and impoundments encountered.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Once samples have been collected, the following procedure should be followed:

- 1. Transfer the sample(s) into suitable, labeled sample containers.
- 2. Preserve the sample if appropriate, or use pre-preserved sample bottles. Do not overfill bottles if they are pre-preserved.
- 3. Cap the container, place in a ziploc plastic bag and cool to 4°C.
- 4. Record all pertinent data in the site logbook and on field data sheets.
- 5. Complete the Chain of Custody record.
- 6. Attach custody seals to cooler prior to shipment.
- 7. Decontaminate all sampling equipment prior to the collection of additional samples with that sampling device.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems with surface water sampling. These include cross contamination of samples and improper sample collection.

- 1. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Refer to the Sampling Equipment Decontamination SOP.
- Improper sample collection can involve using contaminated equipment, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed area.

Following proper decontamination procedures and minimizing disturbance of the sample site will eliminate these problems.

5.0 EQUIPMENT/APPARATUS

Equipment needed for collection of surface water samples may include (depending on technique chosen):

- C Kemmerer bottles
- C Bacon bomb sampler
- C Dip sampler
- C Line and messengers
- C Sample bottles/preservatives
- C Ziploc bags
- C Ice
- C Coolers
- Chain of Custody records, custody seals
- C Field data sheets
- C Decontamination equipment
- C Maps/plot plan
- C Safety equipment
- C Compass
- C Tape measure
- C Survey stakes, flags, or buoys and anchors
- Camera and film
- C Logbook/waterproof pen
- C Sample bottle labels

6.0 REAGENTS

Reagents will be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed.

7.0 PROCEDURES

7.1 Preparation

- 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.
- 2. Obtain the necessary sampling and monitoring equipment.
- 3. Decontaminate or pre-clean equipment, and ensure that it is in working order.
- 4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
- 5. Perform a general site survey prior to site entry, in accordance with the site specific Health and Safety Plan.
- 6. Use stakes, flagging, or buoys to identify and mark all sampling locations. If required the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. If collecting sediment samples, this procedure may disturb the bottom.

7.2 Representative Sampling Considerations

In order to collect a representative sample, the hydrology and morphometrics of a stream or impoundment should be determined prior to sampling. This will aid in determining the presence of phases or layers in lagoons, or impoundments, flow patterns in streams, and appropriate sample locations and depths.

Water quality data should be collected in impoundments, and to determine if stratification is present. Measurements of dissolved oxygen, pH, and temperature can indicate if strata exist which would effect analytical results. Measurements should be collected at one-meter intervals from the substrate to the surface using the appropriate instrument (i.e., a Hydrolab or equivalent).

Water quality measurements such as dissolved oxygen, pH, temperature, conductivity, and oxidation-reduction potential can assist in the interpretation of analytical data and the selection of sampling sites and depths when surface water samples are collected.

Generally, the deciding factors in the selection of a sampling device for sampling liquids in streams, rivers, lakes, ponds, lagoons, and surface impoundments are:

- Will the sample be collected from shore or from a boat?
- 2. What is the desired depth at which you wish to collect the sample?
- 3. What is the overall depth and flow direction of river or stream?
- 4. What type of sample will be collected (i.e., water or lagoon liquids)?

7.2.1 Sampler Composition

The appropriate sampling device must be of a proper composition. Selection of samplers constructed of glass, stainless steel, PVC or PFTE (Teflon) should be based upon the analyses to be performed.

7.3 Sample Collection

7.3.1 Kemmerer Bottle

A Kemmerer bottle (Figure 1, Appendix A) may be used in most situations where site access is from a boat or structure such as a bridge or pier, and where samples at depth are required. Sampling procedures are as follows:

- 1. Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the sampling end pieces (upper and lower stoppers) are pulled away from the sampling tube (body), allowing the substance to be sampled to pass through this tube.
- Lower the pre-set sampling device to the predetermined depth. Avoid bottom disturbance.

- 3. When the Kemmerer bottle is at the required depth, send down the messenger, closing the sampling device.
- 4. Retrieve the sampler and discharge from the bottom drain the first 10-20 mL to clear any potential contamination of the valve. Transfer the sample to the appropriate sample container.

7.3.2 Bacon Bomb Sampler

A bacon bomb sampler (Figure 2, Appendix A) may be used in situations similar to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

- 1. Lower the bacon bomb sampler carefully to the desired depth, allowing the line for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut. This will allow the sampler to fill
- 2. Release the trigger line and retrieve the sampler.
- 3. Transfer the sample to the appropriate sample container by pulling up on the trigger.

7.3.3 Dip Sampler

A dip sampler (Figure 3, Appendix A) is useful in situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

- 1. Assemble the device in accordance with the manufacturer's instructions.
- 2. Extend the device to the sample location and collect the sample by dipping the sampler into the substance.
- 3. Retrieve the sampler and transfer the sample to the appropriate sample container.

7.3.4 Direct Method

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples from the surface directly into the sample bottle. This method is not to be used for sampling lagoons or other impoundments where contact with contaminants is a concern.

Using adequate protective clothing, access the sampling station by appropriate means. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and the boat wake.

When using the direct method, do not use prepreserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

- 1. All data must be documented on field data sheets or within site logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and corporate health and safety procedures.

More specifically, when sampling lagoons or surface impoundments containing known or suspected hazardous substances, adequate precautions must be taken to ensure the safety of sampling personnel. The sampling team member collecting the sample should not get too close to the edge of the impoundment, where bank failure may cause him/her to lose his/her balance. The person performing the sampling should be on a lifeline and be wearing adequate protective equipment. When conducting sampling from a boat in an impoundment or flowing waters, appropriate boating safety procedures should be followed.

12.0 REFERENCES

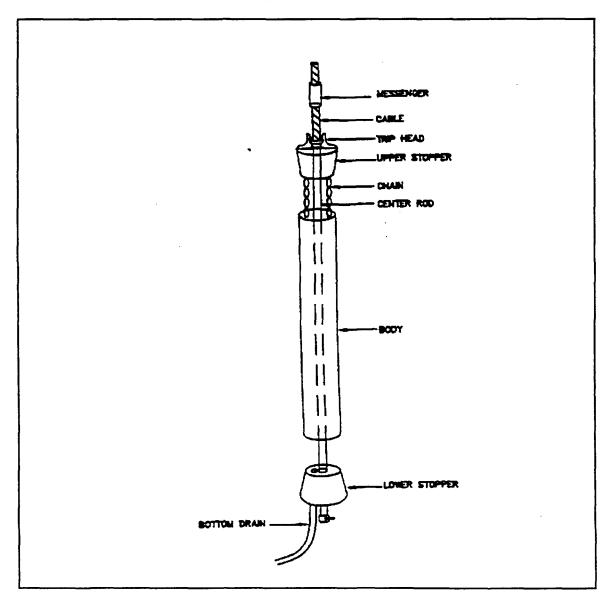
U.S. Geological Survey. 1977. National Handbook or Recommended Methods for Water Data Acquisition. Office of Water Data Coordination Reston, Virginia. (Chapter Updates available).

U.S. Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA/600/4-84-076.

APPENDIX A

Figures

FIGURE 1. Kemmerer Bottle



APPENDIX A (Cont'd)

Figures

FIGURE 2. Bacon Bomb Sampler

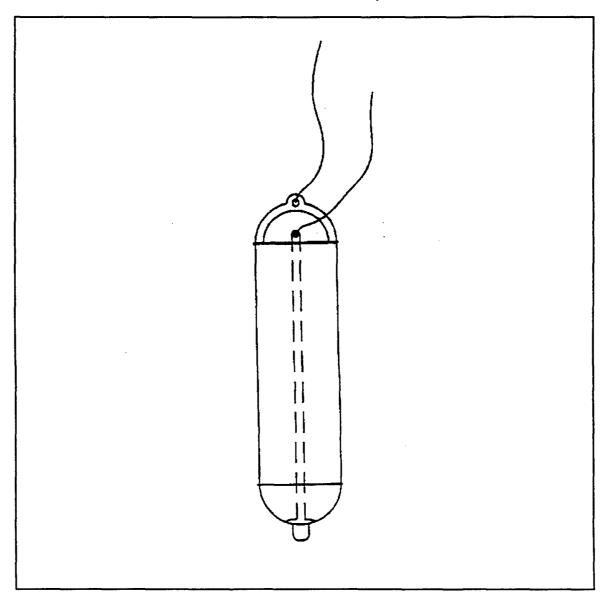
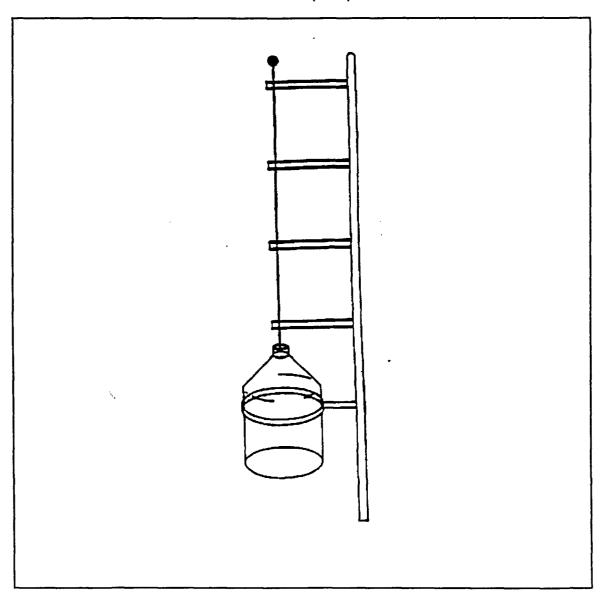


FIGURE 3. Dip Sampler





ASBESTOS SAMPLING

SOP#: 2015 DATE: 11/17/94

REV. #: 0.0

1.0 SCOPE AND APPLICATION

Asbestos has been used in many commercial products including building materials such as flooring tiles and sheet goods, paints and coatings, insulation, and roofing asphalts. These products and others may be found at hazardous waste sites hanging on overhead pipes, contained in drums, abandoned in piles, or as part of a structure. Asbestos tailing piles from mining operations can also be a source of ambient asbestos fibers. Asbestos is a known carcinogen and requires air sampling to assess airborne exposure to human health. This Standard Operating Procedure (SOP) provides procedures for asbestos air sampling by drawing a known volume of air through a mixed cellulose ester (MCE) filter. The filter is then sent to a laboratory for analysis. The U.S. Environmental Protection Agency/Environmental Response Team (U.S. EPA/ERT) uses one of four analytical methods for determining asbestos in air. These include: U.S. EPA's Environmental Asbestos Assessment Manual, Superfund Method for the Determination of Asbestos in Ambient Air for Transmission Electron Microscopy (TEM)(1); U.S. EPA's Modified Yamate Method for TEM(2); National Institute for Occupational Safety and Health (NIOSH) Method 7402 (direct method only) for TEM; and NIOSH Method 7400 for Phase Contrast Microscopy (PCM)(3). Each method has specific sampling and analytical requirements (i.e., sample volume and flow rate) for determining asbestos in air.

The U.S. EPA/ERT typically follows procedures outlined in the TEM methods for determining mineralogical types of asbestos in air and for distinguishing asbestos from non-asbestos minerals. The Phase Contrast Microscopy (PCM) method is used by U.S. EPA/ERT as a screening tool since it is less costly than TEM. PCM cannot distinguish asbestos from non-asbestos fibers, therefore the TEM method may be necessary to confirm analytical results. For example, if an action level for the presence of fibers has been set and PCM analysis indicates that the action level has been exceeded, then

TEM analysis can be used to quantify and identify asbestos structures through examination of their morphology crystal structures (through electron diffraction), and elemental composition (through energy dispersive X-ray analysis). In this instance samples should be collected for both analyses in side by side sampling trains (some laboratories are able to perform PCM and TEM analysis from the same filter). The Superfund method is designed specifically to provide results suitable for supporting risk assessments at Superfund sites, it is applicable to a wide range of ambient air situations at hazardous waste sites. U.S. EPA's Modified Yamate Method for TEM is also used for ambient air sampling due to high volume requirements. The PCM and TEM NIOSH analytical methods require lower sample volumes and are typically used indoors; however, ERT will increase the volume requirement for outdoor application.

Other Regulations pertaining to asbestos have been promulgated by U.S. EPA and OSHA. U.S. EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) regulates asbestos-containing waste materials. NESHAP establishes management practices and standards for the handling of asbestos and emissions from waste disposal operations (40) CFR Part 61, Subparts A and M). U.S. EPA's 40 CFR 763 (July 1, 1987)⁽⁴⁾ and its addendum 40 CFR 763 (October 30, 1987)⁽⁴⁾ provide comprehensive rules for the asbestos abatement industry. State and local regulations on these issues vary and may be more stringent than federal requirements. The OSHA regulations in 29 CFR 1910.1001 and 29 CFR 1926.58 specify work practices and safety equipment such as respiratory protection and protective clothing when handling asbestos. The OSHA standard for an 8-hour, time-weighted average (TWA) is 0.2 fibers/cubic centimeters of air. This standard pertains to fibers with a length-to-width ratio of 3 to 1 with a fiber length >5 μ m^(5,6). An action level of 0.1 fiber/cc (one-half the OSHA standard) is the level U.S. EPA has established in which employers must initiate such activities as air monitoring, employee training, and medical surveillance(5,6).

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Prior to sampling, the site should be characterized by identifying on-site as well as off-site sources of airborne asbestos. The array of sampling locations and the schedule for sample collection, is critical to the success of an investigation. Generally, sampling strategies to characterize a single point source are fairly straightforward, while multiple point sources and area sources increase the complexity of the sampling strategy. It is not within the scope of this SOP to provide a generic asbestos air sampling plan. Experience, objectives, and site characteristics will dictate the sampling strategy.

During a site investigation, sampling stations should be arranged to distinguish spatial trends in airborne asbestos concentrations. Sampling schedules should be fashioned to establish temporal trends. sampling strategy typically requires that the concentration of asbestos at the source (worst case) or area of concern (downwind), crosswind, as well as background (upwind) contributions be quantified. See Table 1 (Appendix A) for U.S. EPA/ERT recommended sampling set up for ambient air. Indoor asbestos sampling requires a different type of strategy which is identified in Table 2 (Appendix A). It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot blanks can be utilized to determine other sources.

Much information can be derived from each analytical method previously mentioned. Each analytical method has specific sampling requirements and produce results which may or may not be applicable to a specific sampling effort. The site sampling

objectives should be carefully identified so as to select the most appropriate analytical method. Additionally, some preparation (i.e., lot blanks results) prior to site sampling may be required, these requirements are specified in the analytical methods.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Sample Preservation

No preservation is required for asbestos samples.

3.2 Sample Handling, Container and Storage Procedures

- 1. Place a sample label on the cassette indicating a unique sampling number. Do not put sampling cassettes in shirt or coat pockets as the filter can pick up fibers. The original cassette box is used to hold the samples.
- 2. Wrap the cassette individually in a plastic sample bag. Each bag should be marked indicating sample identification number, total volume, and date.
- 3. The wrapped sampling cassettes should be placed upright in a rigid container so that the cassette cap is on top and cassette base is on bottom. Use enough packing material to prevent jostling or damage. Do not use vermiculite as packing material for samples. If possible, hand carry to lab.
- 4. Provide appropriate documentation with samples (i.e., chain of custody and requested analytical methodology).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Flow rates exceeding 16 liters/minute (L/min) which could result in filter destruction due to (a) failure of its physical support under force from the increased pressure drop; (b) leakage of air around the filter mount so that the filter is bypassed, or (c) damage to the asbestos structures due to increased impact velocities.

4.1 U.S. EPA's Superfund Method

4.1.1 Direct-transfer TEM Specimen Preparation Methods

Direct-Transfer TEM specimen preparation methods have the following significant interferences:

- by the particulate density on the filter, which in turn is controlled by the sampled air volume and the total suspended particulate concentration in the atmosphere being sampled.
- The precision of the result is dependent on the uniformity of the deposit of asbestos structures on the sample collection filter.
- Air samples must be collected so that they have particulate and fiber loadings within narrow ranges. If too high a particulate loading occurs on the filter, it is not possible to prepare satisfactory TEM specimens by a direct-transfer method. If too high a fiber loading occurs on the filter, even if satisfactory TEM specimens can be prepared, accurate fiber counting will not be possible.

4.1.2 Indirect TEM Specimen Preparation Methods

Indirect TEM specimen preparation methods have the following interferences:

- The size distribution of asbestos structures is modified.
- There is increased opportunity for fiber loss or introduction of extraneous contamination.
- When sample collection filters are ashed, any fiber contamination in the filter medium is concentrated on the TEM specimen grid.

It can be argued that direct methods yield an underestimate of the asbestos structure concentration because many of the asbestos fibers present are concealed by other particulate material with which they are associated. Conversely, indirect methods can be considered to yield an over-estimate because some types of complex asbestos structures disintegrate during the preparation, resulting in an increase in the numbers of structures counted.

4.2 U.S. EPA's Modified Yamate Method for TEM

High concentrations of background dust interfere with fiber identification.

4.3 NIOSH Method for TEM

Other amphibole particles that have aspect ratios greater than 3:1 and elemental compositions similar to the asbestos minerals may interfere in the TEM analysis. Some non-amphibole minerals may give electron diffraction patterns similar to amphiboles. High concentrations of background dust interfere with fiber identification.

4.4 NIOSH Method for PCM

PCM cannot distinguish asbestos from non-asbestos fibers; therefore, all particles meeting the counting criteria are counted as total asbestos fibers. Fiber less than 0.25 um in length will not be detected by this method. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the detection limit.

5.0 EQUIPMENT/MATERIALS

5.1 Sampling Pump

The constant flow or critical orifice controlled sampling pump should be capable of a flow-rate and pumping time sufficient to achieve the desired volume of air sampled.

The lower flow personal sampling pumps generally provide a flow rate of 20 cubic centimeters/minute (cc/min) to 4 L/min. These pumps are usually battery powered. High flow pumps are utilized when flow rates between 2 L/min to 20 L/min are required. High flow pumps are used for short sampling periods so as to obtain the desired sample volume. High flow pumps usually run on AC power and can be plugged into a nearby outlet. If an outlet is not available then a generator should be obtained. The generator should be positioned downwind from the sampling pump. Additional voltage may be required if more than one pump is plugged into the same generator. Several electrical extension cords may be required if sampling locations are remote.

The recommended volume for the Superfund method (Phase I) requires approximately 20 hours to collect. Such pumps typically draw 6 amps at full power so that 2 lead/acid batteries should provide sufficient power to collect a full sample. The use of line

voltage, where available, eliminates the difficulties associated with transporting stored electrical energy.

A stand should be used to hold the filter cassette at the desired height for sampling and the filter cassette shall be isolated from the vibrations of the pump.

5.2 Filter Cassette

The cassettes are purchased with the required filters in position, or can be assembled in a laminar flow hood or clean area. When the filters are in position, a shrink cellulose band or adhesive tape should be applied to cassette joints to prevent air leakage.

5.2.1 TEM Cassette Requirements

Commercially available field monitors, comprising 25 mm diameter three-piece cassettes, with conductive extension cowls shall be used for sample collection. The cassette must be new and not previously used. The cassette shall be loaded with an MCE filter of pore size $0.45~\mu m$, and supplied from a lot number which has been qualified as low background for asbestos determination. The cowls should be constructed of electrically conducting material to minimize electrostatic effects. The filter shall be backed by a $5~\mu m$ pore size MCE filter (Figure 1, Appendix B).

5.2.2 PCM Cassette Requirements

NIOSH Method 7400, PCM involves using a 0.8 to 1.2 μ m mixed cellulose ester membrane, 25 mm diameter, 50 mm conductive cowl on cassette (Figure 2, Appendix B). Some labs are able to perform PCM and TEM analysis on the same filter; however, this should be discussed with the laboratory prior to sampling.

5.3 Other Equipment

- Inert tubing with glass cyclone and hose barb
- Whirlbags (plastic bags) for cassettes
- Tools small screw drivers
- Container to keep samples upright
- Generator or electrical outlet (may not be required)
- Extension cords (may not be required)
- Multiple plug outlet
- Sample labels
- Air data sheets

Chain of Custody records

6.0 REAGENTS

Reagents are not required for the preservation of asbestos samples.

7.0 PROCEDURES

7.1 Air Volumes and Flow Rates

Sampling volumes are determined on the basis of how many fibers need to be collected for reliable measurements. Therefore, one must estimate how many airborne fibers may be in the sampling location.

Since the concentration of airborne aerosol contaminants will have some effect on the sample, the following is a suggested criteria to assist in selecting a flow rate based on real-time aerosol monitor (RAM) readings in milligrams/cubic meter (mg/m³).

	Concentration	<u>Flow</u>
Rate Low RAM readings:	<6.0 mg/m ³	11-15.
L/minMedium RAM readings:L/min	>6.0 mg/m ₃	7.5
High RAM readings: L/min	>10. mg/m ³	2.5

In practice, pumps that are available for environmental sampling at remote locations operate under a maximum load of approximately 12 L/min.

7.1.1 U.S. EPA's Superfund Method

The Superfund Method incorporates an indirect preparation procedure to provide flexibility in the amount of deposit that be can be tolerated on the sample filter and to allow for the selective concentration of asbestos prior to analysis. To minimize contributions to background contamination from asbestos present in the plastic matrices of membrane filters while allowing for sufficient quantities of asbestos to be collected, this method also requires the collection of a larger volume of air per unit area of filter than has traditionally been collected for asbestos analysis. Due to the need to collect large volumes of air, higher sampling flow rates are recommended in this method than have generally been employed for asbestos sampling in the past. As an alternative, samples may be collected over longer time

intervals. However, this restricts the flexibility required to allow samples to be collected while uniform meteorological conditions prevail.

The sampling rate and the period of sampling should be selected to yield as high a sampled volume as possible, which will minimize the influence of filter contamination. Wherever possible, a volume of 15 cubic meters (15,000 L) shall be sampled for those samples intended for analysis only by the indirect TEM preparation method (Phase 1 samples). For those samples to be prepared by both the indirect and the direct specimen preparation methods (Phase 2 samples), the volumes must be adjusted so as to provide a suitably-loaded filter for the direct TEM preparation method. One option is to collect filters at several loadings to bracket the estimated optimum loading for a particular site. Such filters can be screened in the laboratory so that only those filters closest to optimal loading are analyzed. It has been found that the volume cannot normally exceed 5 cubic meters (5000 L) in an urban or agricultural area, and 10 cubic meters (10,000 L) in a rural area for samples collected on a 25 mm filter and prepared by a directtransfer technique.

An upper limit to the range of acceptable flow rates for this method is 15 L/min. At many locations, wind patterns exhibit strong diurnal variations. Therefore, intermittent sampling (sampling over a fixed time interval repeated over several days) may be necessary to accumulate 20 hours of sampling time over constant wind conditions. Other sampling objectives also may necessitate intermittent sampling. The objective is to design a sampling schedule so that samples are collected under uniform conditions throughout the sampling interval. This method provides for such options. Air volumes collected on Phase I samples are maximized (<16 L/min). Air volumes collected on Phase 2 samples are limited to provide optimum loading for filters to be prepared by a direct-transfer procedure.

7.1.2 U.S. EPA's Modified Yamate Method for TEM

U.S. EPA's TEM method requires a minimum volume of 560 L and a maximum volume of 3,800 L in order to obtain an analytical sensitivity of 0.005 structures/cc. The optimal volume for TEM is 1200 L to 1800 L. These volumes are determined using a 200 mesh EM grid opening with a 25-mm filter

cassette. Changes in volume would be necessary if a 37-mm filter cassette is used since the effective area of a 25 mm (385 sq mm) and 37 mm (855 sq m) differ.

7.1.3 NIOSH Method for TEM and PCM

The minimum recommended volume for TEM and PCM is 400 L at 0.1 fiber/cc. Sampling time is adjusted to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for eight hours (700 to 2800 L) is appropriate in non-dusty atmospheres containing 0.1 fiber/cc. Dusty atmospheres i.e., areas with high levels of asbestos, require smaller sample volumes (<400 L) to obtain countable samples.

In such cases, take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high flow rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3,000 to 10,000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust. If > 50% of the filter surface is covered with particles, the filter may be too overloaded to count and will bias the measured fiber concentration. Do not exceed 0.5 mg total dust loading on the filter.

7.2 Calibration Procedures

In order to determine if a sampling pump is measuring the flow rate or volume of air correctly, it is necessary to calibrate the instrument. Sampling pumps should be calibrated immediately before and after each use. Preliminary calibration should be conducted using a primary calibrator such as a soap bubble type calibrator, (e.g., a Buck Calibrator, Gilibrator, or equivalent primary calibrator) with a representative filter cassette installed between the pump and the calibrator. The representative sampling cassette can be reused for calibrating other pumps that will be used for asbestos sampling. The same cassette lot used for sampling should also be used for the calibration. A sticker should be affixed to the outside of the extension cowl marked "Calibration Cassette."

A rotameter can be used provided it has been recently precalibrated with a primary calibrator. Three separate constant flow calibration readings should be obtained both before sampling and after sampling.

Should the flow rate change by more than 5% during the sampling period, the average of the pre- and postcalibration rates will be used to calculate the total sample volume. The sampling pump used shall provide a non-fluctuating air-flow through the filter, and shall maintain the initial volume flow-rate to within ± 10% throughout the sampling period. The mean value of these flow-rate measurements shall be used to calculate the total air volume sampled. A constant flow or critical orifice controlled pump meets these requirements. If at any time the measurement indicates that the flow-rate has decreased by more than 30%, the sampling shall be terminated. Flexible tubing is used to connect the filter cassette to the sampling pump. Sampling pumps can be calibrated prior to coming on-site so that time is saved when performing on-site calibration.

- 7.2.1 Calibrating a Personal Sampling Pump with an Electronic Calibrator
- See Manufacturer's manual for operational instructions.
- 2. Set up the calibration train as shown in (Figure 3, Appendix B) using a sampling pump, electronic calibrator, and a representative filter cassette. The same lot sampling cassette used for sampling should also be used for calibrating.
- 3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 foot) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the electronic calibrator.
- 4. Turn the electronic calibrator and sampling pump on. Create a bubble at the bottom of the flow chamber by pressing the bubble initiate button. The bubble should rise to the top of the flow chamber. After the bubble runs its course, the flow rate is shown on the LED display.
- 5. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.
- 6. Perform the calibration three times until the desired flow rate of \pm 5% is attained.
- 7.2.2 Calibrating a Rotameter with an Electronic Calibrator
- See manufacturer's manual for operational instructions.
- 2. Set up the calibration train as shown in (Figure 4, Appendix B) using a sampling pump, rotameter, and electronic calibrator.
- 3. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° vertical
- 4. Turn the electronic calibrator and sampling pump on.

- 5. Create a bubble at the bottom of the flow chamber by pressing the bubble initiate button. The bubble should rise to the top of the flow chamber. After the bubble runs its course, the flow rate is shown on the LED display.
- 6. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.
- 7. Record the electronic calibrator flow rate reading and the corresponding rotameter reading. Indicate these values on the rotameter (sticker). The rotameter should be able to work within the desired flow range. Readings can also be calibrated for 10 cm³ increments for Low Flow rotameters, 500 cm³ increments for medium flow rotameters and 1 liter increments for high flow rotameters.
- 8. Perform the calibration three times until the desired flow rate of \pm 5% is attained. Once on site, a secondary calibrator, i.e., rotameter may be used to calibrate sampling pumps.
- 7.2.3 Calibrating a Personal Sampling
 Pump with a Rotameter
- See manufacturer's manual for Rotameter's Operational Instructions.
- 2. Set up the calibration train as shown in (Figure 5, Appendix B) using a rotameter, sampling pump, and a representative sampling cassette.
- 3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 ft) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter.
- 4. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° vertical.
- 5. Turn the sampling pump on.
- 6. Turn the flow adjust screw (or knob) on the

personal sampling pump until the float ball on the rotameter is lined up with the precalibrated flow rate value. A sticker on the rotameter should indicate this value.

7. A verification of calibration is generally performed on-site in the clean zone immediately prior to the sampling.

7.3. Meteorology

It is recommended that a meteorological station be established. If possible, sample after two to three days of dry weather and when the wind conditions are at 10 mph or greater. Record wind speed, wind direction, temperature, and pressure in a field logbook. Wind direction is particularly important when monitoring for asbestos downwind from a fixed source.

7.4 Ambient Sampling Procedures

7.4.1 Pre-site Sampling Preparation

- 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.
- 2. Obtain necessary sampling equipment and ensure it is in working order and fully charged (if necessary).
- 3. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety plan.
- 4. Once on-site the calibration is performed in the clean zone. The calibration procedures are listed in Section 7.2.
- 5. After calibrating the sampling pump, mobilize to the sampling location.

7.4.2 Site Sampling

1. To set up the sampling train, attach the air intake hose to the cassette base. Remove the cassette cap (Figure 6 and 7, Appendix B). The cassette should be positioned downward, perpendicular to the wind

- 2. If AC or DC electricity is required then turn it on. If used, the generator should be placed 10 ft. downwind from the sampling pump.
- 3. Record the following in a field logbook: date, time, location, sample identification number, pump number, flow rate, and cumulative time.
- 4. Turn the pump on. Should intermittent sampling be required, sampling filters must be covered between active periods of sampling. To cover the sample filter: turn the cassette to face upward, place the cassette cap on the cassette, remove the inlet plug from the cassette cap, attach a rotameter to the inlet opening of the cassette cap to measure the flow rate, turn off the sampling pump, place the inlet plug into the inlet opening on the cassette cap. To resume sampling: remove the inlet plug, turn on the sampling pump, attach a rotameter to measure the flow rate, remove the cassette cap, replace the inlet plug in the cassette cap and invert the cassette, face downward and perpendicular to the wind.
- 5. Check the pump at sampling midpoint if sampling is longer than 4 hours. The generators may need to be regased depending on tank size. If a filter darkens in appearance or if loose dust is seen in the filter, a second sample should be started.
- 6. At the end of the sampling period, orient the cassette up, turn the pump off.
- 7. Check the flow rate as shown in Section 7.2.3. When sampling open-faced, the sampling cap should be replaced before post calibrating. Use the same cassette used for sampling for post calibration (increase dust/fiber loading may have altered the flow rate.
- 8. Record the post flow rate.
- Record the cumulative time or run.
- 10. Remove the tubing from the sampling cassette. Still holding the cassette upright, replace the inlet plug on the cassette cap and the outlet plug on the cassette base.

7.4.3. Post Site Sampling

- Follow handling procedures in Section 3.2, steps 1-4.
- Obtain an electronic or hard copy of meteorological data which occurred during the sampling event. Record weather: wind speed, ambient temperature, wind direction, and precipitation. Obtaining weather data several days prior to the sampling event can also be useful.

7.5 Indoor Sampling Procedures

PCM analysis is used for indoor air samples. When analysis shows total fiber count above the OSHA action level 0.1 f/cc then TEM (U.S. EPA's Modified Yamate Method) is used to identify asbestos from non-asbestos fibers.

Sampling pumps should be placed four to five feet above ground level away from obstructions that may influence air flow. The pump can be placed on a table or counter. Refer to Table 2 (Appendix A) for a summary of indoor sampling locations and rationale for selection.

Indoor sampling utilizes high flow rates to increased sample volumes (2000 L for PCM and 2800 to 4200 L for TEM) in order to obtain lower detection limits below the standard, (i.e., 0.01 f/cc or lower [PCM] and 0.005 structures/cc or lower [TEM]).

7.5.1 Aggressive Sampling Procedures

Sampling equipment at fixed locations may fail to detect the presence of asbestos fibers. Due to limited air movement, many fibers may settle out of the air onto the floor and other surfaces and may not be captured on the filter. In the past, an 8-hour sampling period was recommended to cover various air circulation conditions. A quicker and more effective way to capture asbestos fibers is to circulate the air artificially so that the fibers remain airborne during sampling. The results from this sampling option typifies worst case condition. This is referred to as aggressive air sampling for asbestos. Refer to Table 2 for sample station locations.

1. Before starting the sampling pumps, direct forced air (such as a 1-horsepower leaf

blower or large fan) against walls, ceilings, floors, ledges, and other surfaces in the room to initially dislodge fibers from surfaces. This should take at least 5 minutes per 1000 sq. ft. of floor.

- Place a 20-inch fan in the center of the room.
 (Use one fan per 10,000 cubic feet of room space.) Place the fan on slow speed and point it toward the ceiling.
- 3. Follow procedures in Section 7.4.1 and 7.4.2 (Turn off the pump and then the fan(s) when sampling is complete.).
- 4. Follow handling procedures in Section 3.2, steps 1-4.

8.0 CALCULATIONS

The sample volume is calculated from the average flow rate of the pump multiplied by the number of minutes the pump was running (volume = flow rate X time in minutes). The sample volume should be submitted to the laboratory and identified on the chain of custody for each sample (zero for lot, field and trip blanks).

The concentration result is calculated using the sample volume and the numbers of asbestos structures reported after the application of the cluster and matrix counting criteria.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

Follow all QA/QC requirements from the laboratories as well as the analytical methods.

9.1 TEM Requirements

- 1. Examine lot blanks to determine the background asbestos structure concentration.
- 2. Examine field blanks to determine whether there is contamination by extraneous asbestos structures during specimen preparation.
- 3. Examine of laboratory blanks to determine if contamination is being introduced during critical phases of the laboratory program.

- 4. To determine if the laboratory can satisfactorily analyze samples of known asbestos structure concentrations, reference filters shall be examined. Reference filters should be maintained as part of the laboratory's Quality Assurance program.
- 5. To minimize subjective effects, some specimens should be recounted by a different microscopist.
- 6. Asbestos laboratories shall be accredited by the National Voluntary Laboratory Accreditation Program.
- At this time, performance evaluation samples for asbestos in air are not available for Removal Program Activities.

9.2 PCM Requirements

- 1. Examine reference slides of known concentration to determine the analyst's ability to satisfactorily count fibers. Reference slides should be maintained as part of the laboratory's quality assurance program.
- 2. Examine field blanks to determine if there is contamination by extraneous structures during sample handling.
- 3. Some samples should be relabeled then submitted for counting by the same analyst to determine possible bias by the analyst.
- 4. Participation in a proficiency testing program such as the AIHA-NIOSH proficiency analytical testing (PAT) program.

10.0 DATA VALIDATION

Results of quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures. More specifically, when entering

an unknown situation involving asbestos, a powered air purifying respirator (PAPR) (full face-piece) is necessary in conjunction with HEPA filter cartridges. See applicable regulations for action level, PEL, TLV, etc. If previous sampling indicates asbestos concentrations are below personal health and safety levels, then Level D personal protection is adequate.

12.0 REFERENCES

- Environmental Asbestos Assessment Manual, Superfund Method for the Determination of Asbestos in Ambient Air, Part 1: Method, EPA/540/2-90/005a, May 1990, and Part 2: Technical Background Document, EPA/540/2-90/005b, May 1990.
- Methodology for the Measurement of Airborne Asbestos by Electron Microscopy, EPA's Report No. 68-02-3266, 1984, G. Yamate, S.C. Agarwal, and R. D. Gibbons.
- National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Method. Third Edition, 1987.
- U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 763. July 1, 1987. Code of Federal Regulations 40 CFR 763 Addendum. October 30, 1987.
- U.S. Environmental Protection Agency. Asbestos-Containing Materials in Schools; Final Rule and Notice. 52 FR 41826.
- (6) Occupational Safety and Health Administration. Code of Federal Regulations 29 CFR 1910.1001. Washington, D.C. 1987.

APPENDIX A

Tables

TABLE 1. SAMPLE STATIONS FOR OUTDOOR SAMPLING			
Sample Station Location	Sample Numbers	Rationale	
Upwind/Background ⁽¹⁾	Collect a minimum of two simultaneous upwind/background samples 30° apart from the prevailing windlines.	Establishes background fiber levels.	
Downwind	Deploy a minimum of 3 sampling stations in a 180 degree arc downwind from the source.	Indicates if asbestos is leaving the site.	
Site Representative and/or Worst Case	Obtain one site representative sample which shows average condition on-site or obtain worst case sample (optional).	Verify and continually confirm and document selection of proper levels of worker protection.	

⁽¹⁾ More than one background station may be required if the asbestos originates from different sources.

Tables

TABLE 2 SAMPLE STATIONS FOR INDOOR SAMPLING			
Sample Station Location	Sample Numbers	Rationale	
Indoor Sampling	If a work site is a single room, disperse 5 samplers throughout the room. If the work site contains up to 5 rooms, place at least one sampler in each room. If the work site contains more than 5 rooms, select a representative sample of the rooms.	Establishes representative samples from a homogeneous area.	
Upwind/Background	If outside sources are suspected, deploy a minimum of two simultaneous upwind/background samples 30° apart from the prevailing windlines.	Establish whether indoor asbestos concentrations are coming from an outside source.	
Worst Case	Obtain one worst case sample, i.e., aggressive sampling (optional).	Verify and continually confirm and document selection of proper levels of worker protection.	

APPENDIX B

FIGURE 1. Transmission Electron Microscopy Filter Cassette

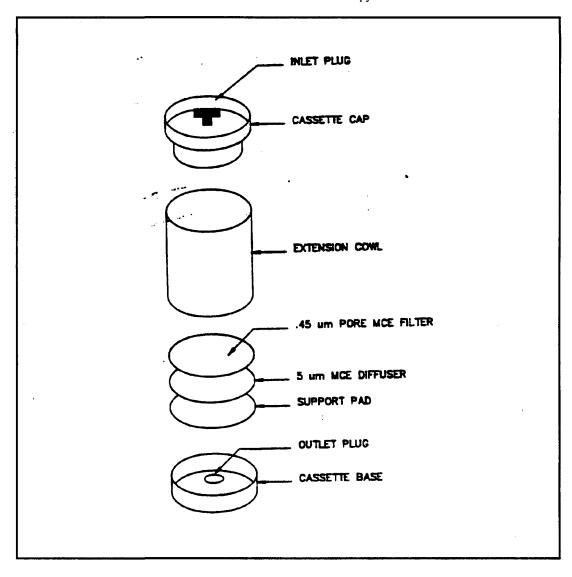


FIGURE 2. Phase Contrast Microscopy Filter Cassette

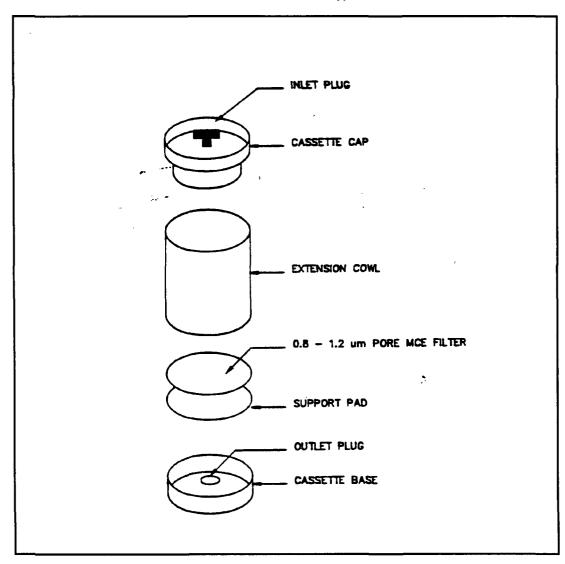


FIGURE 3. Calibrating a Personal Sampling Pump with a Bubble Meter

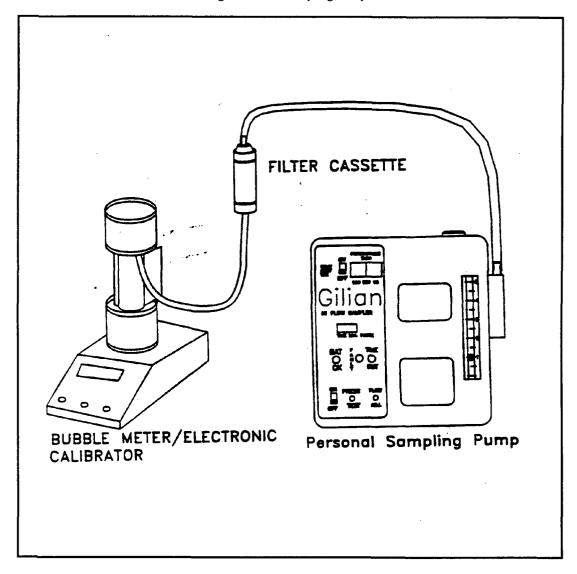


FIGURE 4. Calibrating a Rotameter with a Bubble Meter

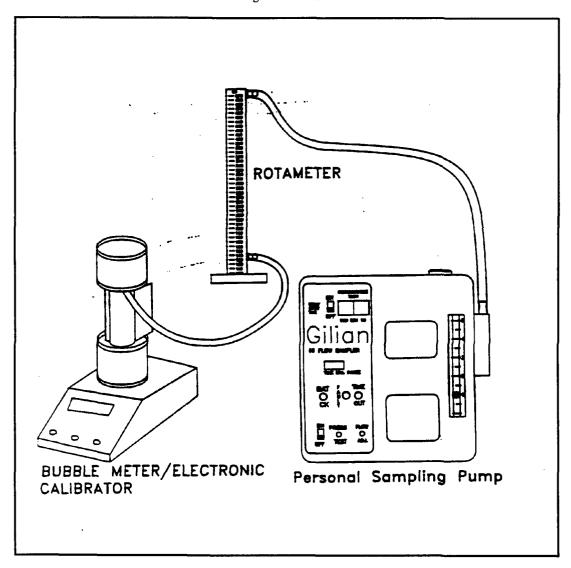


FIGURE 5. Calibrating a Sampling Pump with a Rotameter

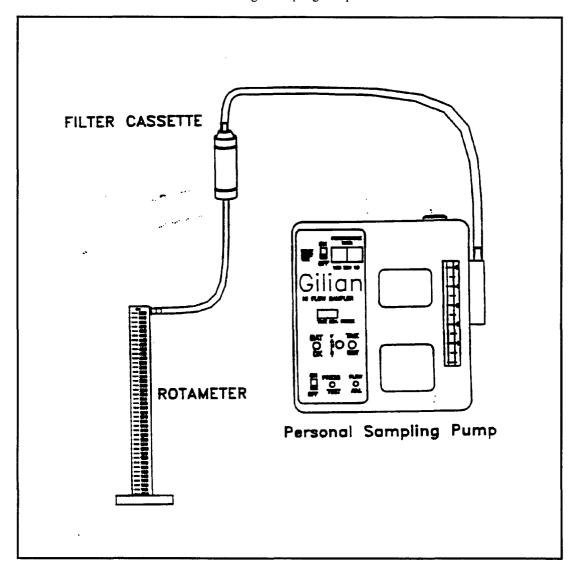


FIGURE 6. Personal Sampling Train for Asbestos

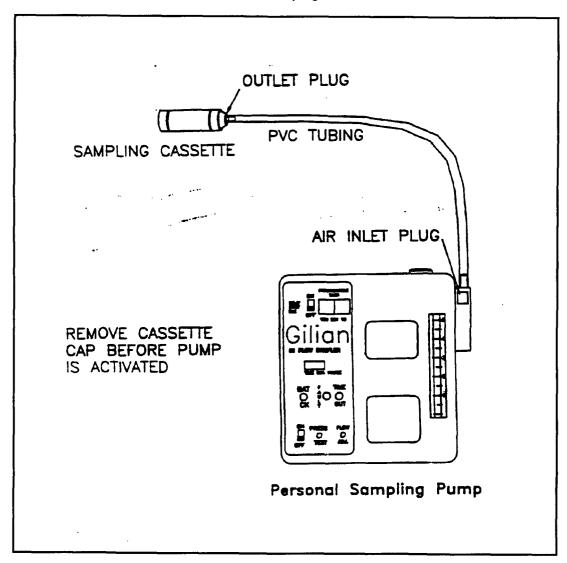
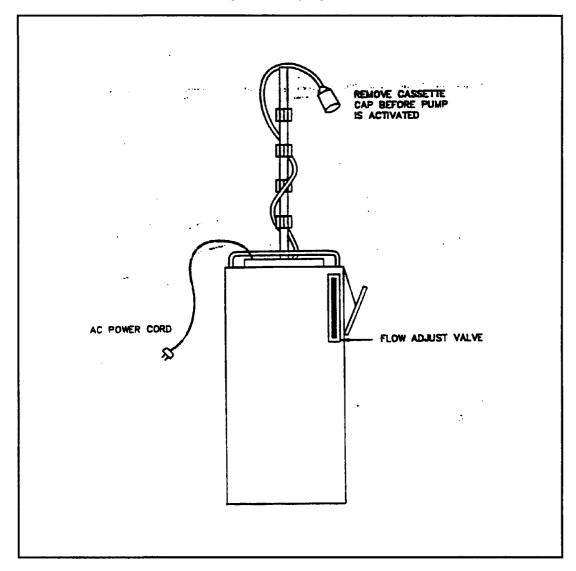


FIGURE 7. High Flow Sampling Train for Asbestos





SEDIMENT SAMPLING

SOP#: 2016 DATE: 11/17/94

REV. #: 0.0

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) is applicable to the collection of representative sediment samples. Analysis of sediment may be biological, chemical, or physical in nature and may be used to determine the following:

- toxicity;
- biological availability and effects of contaminants;
- benthic biota;
- extent and magnitude of contamination;
- contaminant migration pathways and source;
- fate of contaminants;
- grain size distribution.

The methodologies discussed in this SOP are applicable to the sampling of sed iment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. However, if modifications occur, they should be documented in a site or personal logbook and discussed in reports summarizing field activities and analytical results.

For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, and impoundments; or flowing, as in rivers and streams.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Sediment samples may be collected using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile required (surface vs. subsurface), the type of sample required (disturbed vs. undisturbed), contaminants present, and sediment type.

Sediment is collected from beneath an aqueous layer either directly, using a hand held device such as a shovel, trowel, or auger; or indirectly, using a remotely activated device such as an Ekman or Ponar dredge. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size and construction for the analyses requested. If composite sampling techniques are employed, multiple grabs are placed into a container constructed of inert material, homogenized, and transferred to sample containers appropriate for the analyses requested. The homogenization procedure should not be used if sample analysis includes volatile organics; in this case, sediment, or multiple grabs of sediment, should be transferred directly from the sample collection device or homogenization container to the sample container.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

- 1. Chemical preservation of solids is generally not recommended. Cooling to 4°C is usually the best approach, supplemented by the appropriate holding time for the analyses requested.
- Wide mouth glass containers with Teflon lined caps are utilized for sediment samples.
 The sample volume is a function of the analytical requirements and will be specified in the Work Plan.
- 3. If analysis of sediment from a discrete depth or location is desired, sediment is transferred directly from the sampling device to a labeled sample container(s) of appropriate size and construction for the analyses

requested. Transfer is accomplished with a stainless steel or plastic lab spoon or equivalent.

- 4. If composite sampling techniques or multiple grabs are employed, equal portions of sediment from each location are deposited into a stainless steel, plastic, or other appropriate composition (e.g., Teflon) containers. The sediment is homogenized thoroughly to obtain a composite representative of the area sampled. The composite sediment sample is transferred to a labeled container(s) of appropriate size and construction for the analyses requested. Transfer of sediment is accomplished with a stainless steel or plastic lab spoon or equivalent. Samples for volatile organic analysis must be transferred directly from the sample collection device or pooled from multiple areas in the homogenization container prior to mixing. This is done to minimize loss of contaminant due to volatilization during homogenization.
- 5. All sampling devices should decontaminated, then wrapped in aluminum foil. The sampling device should remain in this wrapping until it is needed. Each sampling device should be used for only one sample. Disposable sampling devices for sediment are generally impractical due to cost and the large number of sediment samples which may be required. Sampling devices should be cleaned in the field usin g the decontamination procedure described in the Sampling Equipment Decontamination SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Substrate particle size and organic matter content are a direct consequence of the flow characteristics of a waterbody. Contaminants are more likely to be concentrated in sediments typified by fine particle size and a high organic matter content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic matter content do not typically concentrate pollutants and are generally found in erosional zones. The selection of a sampling location

can, therefore, greatly influence the analytical results and should be justified and specified in the Work Plan.

5.0 EQUIPMENT/APPARATUS

Equipment needed for collection of sediment samples may include:

- Maps/piot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels
- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel
- Bucket auger
- Tube auger
- Extension rods
- "T" handle
- Sediment coring device (tube, drive head, eggshell check value, nosecone, acetate tube, extension rods, "T" handle)
- Ponar dredge
- Ekman dredge
- Nylon rope or steel cable
- Messenger device

6.0 REAGENTS

Reagents are not used for preservation of sediment samples. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP.

7.0 PROCEDURES

7.1 Preparation

- 1. Determine the objective(s) and extent of the sampling effort. The sampling methods to be employed, and the types and amounts of equipment and supplies required will be a function of site characteristics and objectives of the study.
- 2. Obtain the necessary sampling and monitoring equipment.
- 3. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
- 4. Decontaminate or preclean equipment, and ensure that it is in working order.
- 5. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
- 6. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors including flow regime, basin morphometry, sediment characteristics, depth of overlying aqueous layer, contaminant source, and extent and nature of contamination should be considered when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

7.2 Sample Collection

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sampling location, and (2) the physical characteristics of the sediment to be sampled. The following procedures may be utilized:

7.2.1 Sampling Surface Sediment with a Trowel or Scoop from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth and

a shallow aqueous layer is considered to range from 0 to 12 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with tools such as spades, shovels, trowels, and scoops. Although this method can be used to collect both unconsolidated/consolidated sediment, it is limited somewhat by the depth and movement of the aqueous layer. Deep and rapidly flowing water render this method less accurate than others discussed below. However, representative samples can be collected with this procedure in shallow sluggish water provided care is demonstrated by the sample team member. A stainless steel or plastic sampling implement will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials; plating is particularly common with garden trowels.

The following procedure will be used to collect sediment with a scoop, shovel, or trowel:

- 1. Using a decontaminated sampling implement, remove the desired thickness and volume of sediment from the sampling area.
- Transfer the sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.
- 3. Surface water should be decanted from the sample or homogenization container prior to sealing or transfer; care should be taken to retain the fine sediment fraction during this procedure.
- 7.2.2 Sampling Surface Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of bucket auger or tube auger, a series of extensions, and a "T" handle (Figure 1, Appendix A). The use of additional extensions in conjunction with a bucket auger can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. However, sample handling and manipulation increases

in difficulty with increasing depth of water. The bucket auger or tube auger is driven into the sediment and used to extract a core. The various depths represented by the core are homogenized or a subsample of the core is taken from the appropriate depth.

The following procedure will be used to collect sediment samples with a bucket auger or tube auger:

- 1. An acetate core may be inserted into the bucket auger or tube auger prior to sampling if characteristics of the sediments or waterbody warrant. By using this technique, an intact core can be extracted.
- 2. Attach the auger head to the required length of extensions, then attach the "T" handle to the upper extension.
- Clear the area to be sampled of any surface debris.
- 4. Insert the bucket auger or tube auger into the sediment at a 0° to 20° angle from vertical. This orientation minimizes spillage of the sample from the sampler upon extraction from the sediment and water.
- 5. Rotate the auger to cut a core of sediment.
- 6. Slowly withdraw the auger; if using a tube auger, make sure that the slot is facing upward.
- 7. Transfer the sample or a specified aliquot of sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.
- 7.2.3 Sampling Deep Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, deep sediment is considered to range from six to greater than 18 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches. Collection of deep sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a bucket auger, a tube auger, a series of extensions and a

"T" handle. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to five feet or more. However, water clarity must be high enough to permit the sampler to directly observe the sampling In addition, sample handling and operation. manipulation increases in difficulty with increasing depth of water. The bucket auger is used to bore a hole to the upper range of the desired sampling depth and then withdrawn. The tube auger is then lowered down the borehole, and driven into the sediment to the lower range of the desired sampling depth. The tube is then withdrawn and the sample recovered from the tube. This method can be used to collect firmly consolidated sediments, but is somewhat limited by the depth of the aqueous layer, and the integrity of the initial borehole.

The following procedure will be used to collect deep sediment samples with a bucket auger and a tube auger:

- 1. Attach the bucket auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
- 2. Clear the area to be sampled of any surface debris.
- Begin augering, periodically removing any accumulated sediment (i.e., cuttings) from the auger bucket. Cuttings should be disposed of far enough from the sampling area to minimize cross contamination of various depths.
- 4. After reaching the upper range of the desired depth, slowly and carefully remove bucket auger from the boring.
- 5. Attach the tube auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
- 6. Carefully lower tube auger down borehole using care to avoid making contact with the borehole sides and, thus, cross contaminating the sample. Gradually force tube auger into sediment to the lower range of the desired sampling depth. Hammering of the tube auger to facilitate coring should be avoided as the vibrations may cause the boring walls

to collapse.

- 7. Remove tube auger from the borehole, again taking care to avoid making contact with the borehole sides and, thus, cross contaminating the sample.
- 8. Discard the top of core (approximately 1 inch); as this represents material collected by the tube auger before penetration to the layer of concern.
- 9. Transfer sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.
- 7.2.4 Sampling Surface Sediment with an Ekman or Ponar Dredge from Beneath a Shallow or Deep Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth. Collection of surface sediment can be accomplished with a system consisting of a remotely activated device (dredge) and a deployment system. This technique consists of lowering a sampling device (dredge) to the surface of the sediment by use of a rope, cable, or extended handle. The mechanism is activated, and the device entraps sediment in spring loaded or lever operated jaws.

An Ekman dredge is a lightweight sediment sampling device with spring activated jaws. It is used to collect moderately consolidated, fine textured sediment. The following procedure will be used for collecting sediment with an Ekman dredge (Figure 2, Appendix A):

- 1. Attach a sturdy nylon rope or stainless steel cable through the hole on the top of the bracket, or secure the extension handle to the bracket with machine bolts.
- 2. Attach springs to both sides of the jaws. Fix the jaws so that they are in open position by placing trip cables over the release studs. Ensure that the hinged doors on the dredge top are free to open.
- 3. Lower the sampler to a point 4 to 6 inches

above the sediment surface.

- 4. Drop the sampler to the sediment.
- 5. Trigger the jaw release mechanism by lowering a messenger down the line, or by depressing the button on the upper end of the extension handle.
- Raise the sampler and slowly decant any free liquid through the top of the sampler. Car e should be taken to retain the fine sedimen t fraction during this procedure.
- 7. Open the dredge jaws and transfer the sample into a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers adequately have been decontaminated. If necessary, continue to collect additional sediment grabs until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

A Ponar dredge is a heavyweight sediment sampling device with weighted jaws that are lever or spring activated. It is used to collect consolidated fine to coarse textured sediment. The following procedure will be used for collecting sediment with a Ponar dredge (Figure 3, Appendix A):

- 1. Attach a sturdy nylon rope or steel cable to the ring provided on top of the dredge.
- Arrange the Ponar dredge with the jaws in the open position, setting the trip bar so the sampler remains open when lifted from the top. If the dredge is so equipped, place the spring loaded pin into the aligned holes in the trip bar.
- 3. Slowly lower the sampler to a point approximately two inches above the sediment.
- 4. Drop the sampler to the sediment. Slack on

the line will release the trip bar or spring loaded pin; pull up sharply on the line closing the dredge.

- 5. Raise the dredge to the surface and slowly decant any free liquid through the screens on top of the dredge. Care should be taken to retain the fine sediment fraction during this operation.
- 6. Open the dredge and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenized and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

7.2.5 Sampling Subsurface Sediment with a Coring Device from Beneath a Shallow Aqueous Layer

For purposes of this method, subsurface sediment is considered to range from 6 to 24 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of subsurface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a tube sampler, acetate tube, eggshell check valve, nosecone, extensions, and "T" handle, or drivehead. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. This sampler may be used with either a drive hammer for firm sediment, or a "T" handle for soft sediment. However, sample handling and manipulation increases in difficulty with increasing depth of water.

The following procedure describes the use of a sample coring device (Figure 4, Appendix A) used to collect subsurface sediments.

1. Assemble the coring device by inserting the acetate core into the sampling tube.

- 2. Insert the "egg shell" check valve into the lower end of the sampling tube with the convex surface positioned inside the acetate core.
- 3. Screw the nosecone onto the lower end of the sampling tube, securing the acetate tube and eggshell check valve.
- 4. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.
- 5. Place the sampler in a perpendicular position on the sediment to be sampled.
- 6. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. After the desired depth is reached, rotate the sampler to shear off the core at the bottom. Slowly withdraw the sampler from the sediment and proceed to Step 15.
- 7. If the drive hammer is selected, insert the tapered handle (drive head) of the drive hammer through the drive head.
- 8. Drive the sampler into the sediment to the desired depth.
- 9. Record the length of the tube that penetrated the sample material, and the number of blows required to obtain this depth.
- 10. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.
- 11. Rotate the sampler to shear off the core at the bottom.
- 12. Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head, and rotate about 90°.
- 13. Slowly withdraw the sampler from the sediment. If the drivehead was used, pull the hammer upwards and dislodge the sampler from the sediment.

- Carefully remove the coring device from the water.
- 15. Unscrew the nosecone and remove the eggshell check valve.
- 16. Slide the acetate core out of the sampler tube. Decant surface water, using care to retain the fine sediment fraction. If head space is present in the upper end, a hacksaw may be used to shear the acetate tube off at the sediment surface. The acetate core may then be capped at both ends. Indicate on the acetate tube the appropriate orientation of the sediment core using a waterproof marker. The sample may be used in this fashion, or the contents transferred to a sample or homogenization container.
- 17. Open the acetate tube and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality as surance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA/OSHA and Corporate health and safety procedures.

More specifically, when sampling sediment from waterbodies, physical hazards must be identified and adequate precautions must be taken to ensure the safety of the sampling team. The team member collecting the sample should not get too close to the edge of the waterbody, where bank failure may cause loss of balance. To prevent this, the person performing the sampling should be on a lifeline, and be wearing adequate protective equipment. If sampling from a vessel is determined to be necessary, appropriate protective measures must be implemented.

12.0 REFERENCES

Mason, B.J., Preparation of Soil Sampling Protocol: Technique and Strategies. 1983 EPA-600/4-83-020.

Barth, D.S. and B.J. Mason, Soil Sampling Qualit y Assurance User's Guide. 1984 EPA-600/4-84-043.

U.S. EPA. Characterization of Haza rdous Waste Sites
- A Methods Manual: Volume II. Available Sampling Methods, Second Edition. 1984 EPA - 600/4-84-076.

de Vera, E.R., B.P. Simm ons, R.D. Stephen, and D.L. Storm. Samplers and Sampling Procedures for Hazardous Waste Streams. 1980 EPA-600/2-80-018.

APPENDIX A

FIGURE 1. Sampling Auger

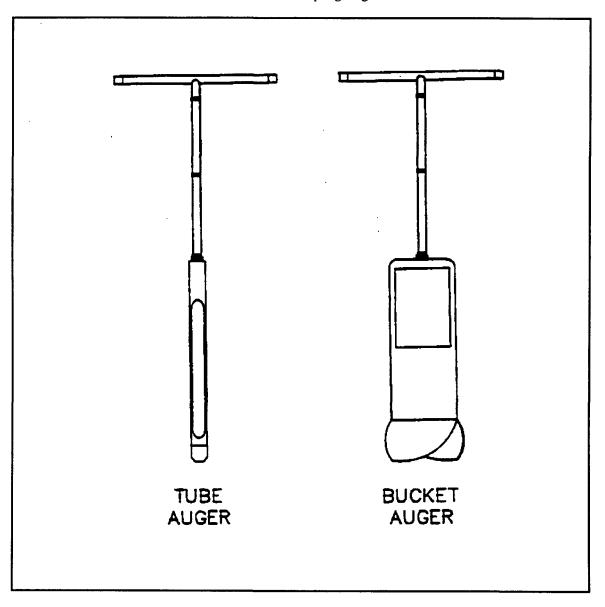


FIGURE 2. Ekman Dredge

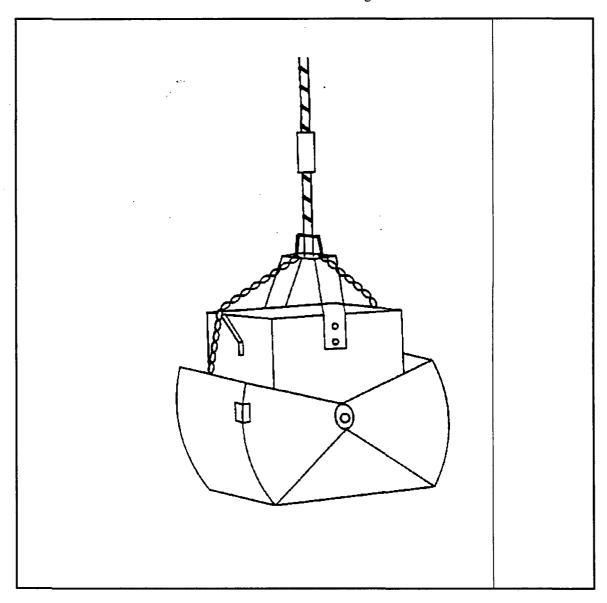


FIGURE 3. Ponar Dredge

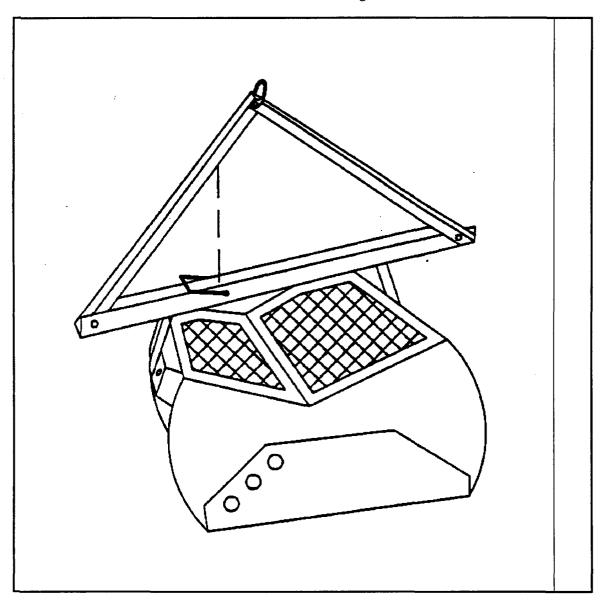
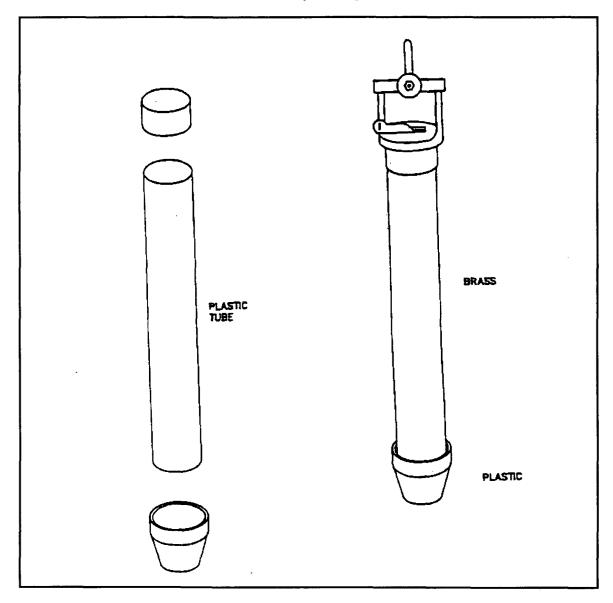


FIGURE 4. Sample Coring Device





SOIL GAS SAMPLING

SOP#: 2042 DATE: 06/01/96

REV. #: 0.0

1.0 SCOPE AND APPLICATION

Soil gas monitoring provides a quick means of waste site evaluation. Using this method, underground contamination can be identified, and the source, extent, and movement of the pollutants can be traced.

This standard operating procedure (SOP) outlines the methods used by U.S. EPA/ERT in installing soil gas wells; measuring organic vapor levels in the soil gas using a Photoionization Detector (PID), Flame Ionization Detector (FID) and/or other air monitoring devices; and sampling the soil gas using Tedlar bags, Tenax sorbent tubes, and/or Summa canisters.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

A 3/8" diameter hole is driven into the ground to a depth of four to five feet using a commercially available slam bar. Soil gas can also be sampled at other depths by the use of a longer bar or bar attachments. A 1/4" O.D. stainless steel probe is inserted into the hole. The hole is then sealed around the top of the probe using modeling clay. The gas contained in the interstitial spaces of the soil is sampled by pulling the sample through the probe using an air sampling pump. The sample may be stored in Tedlar bags, drawn through sorbent cartridges, or analyzed directly using a direct reading instrument. The air sampling pump is not used for Summa canister sampling of soil gas. Sampling is

achieved by soil gas equilibration with the evacuated Summa canister.

Other field air monitoring devices, such as the combustible gas indicator (MSA CGI/02 Meter, Model 260) and the Organic Vapor Analyzer (Foxboro OVA, Model 128), can also be used dependent on specific site conditions. Measurement of soil temperature using a temperature probe may also be desirable. Bagged samples are usually analyzed in a field laboratory using a portable Photovac GC.

Power driven sampling probes may be utilized when soil conditions make sampling by hand unfeasible (i.e., frozen ground, very dense clays, pavement, etc.). Commercially available soil gas sampling probes (hollow, 1/2 = O.D. steel probes) can be driven to the desired depth using a power hammer (e.g., Bosch Demolition Hammer or GeoprobeTM). Samples can be drawn through the probe itself, or through Teflon tubing inserted through the probe and attached to the probe point. Samples are collected and analyzed as described above.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Tedlar Bags

Soil gas samples are generally contained in 1.0-L Tedlar bags. Bagged samples are best stored in dark plastic bags placed in coolers to protect the bags from any damage that may occur in the field or in transit. In addition, coolers insure the integrity of the samples by keeping them at a cool temperature and out of direct sunlight. Samples should be analyzed as soon as possible, preferably within 24 - 48 hours.

3.2 Tenax Tubes

Bagged samples can also be drawn onto Tenax or

other sorbent tubes to undergo lab GC/MS analysis. If Tenax tubes are to be utilized, special care must be taken to avoid contamination. Handling of the tubes should be kept to a minimum and only while wearing nylon or other lint-free gloves. After sampling, each tube should be stored in a clean, sealed culture tube; the ends packed with clean glass wool to protect the sorbent tube from breakage. The culture tubes should be kept cool and wrapped in aluminum foil to prevent any photodegradation of samples (see Section 7.4.).

3.3 Summa Canisters

The Summa canisters used for soil gas sampling have a 6 liter sample capacity and are certified clean by GC/MS analysis before being utilized in the field. After sampling is completed, they are stored and shipped in travel cases.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 PID Measurements

A number of factors can affect the response of a PID (such as the HNu PI 101). High humidity can cause lamp fogging and decreased sensitivity. This can be significant when soil moisture levels are high, or when a soil gas well is actually in groundwater. High concentrations of methane can cause a downscale deflection of the meter. High and low temperature, electrical fields, FM radio transmission, and naturally occurring compounds, such as terpenes in wooded areas, will also affect instrument response.

Other field screening instruments can be affected by interferences. Consult the manufacturers manuals.

4.2 FID Measurements

A number of factors can affect the response of an FID (such as the OVA model 128). High humidity can cause the FID to flame out or not ignite at all. This can be significant when soil moisture levels are high, or when a soil gas well is actually in groundwater. The FID can only read organic based compounds (they must contain carbon in the molecular structure). The FID also responds poorly to hydrocarbons and halogenated hydrocarbons (such as gasoline, propane fuel). High and low temperature, electrical fields and FM radio transmission will also affect instrument response.

4.3 Factors Affecting Organic Concentrations in Soil Gas

Concentrations in soil gas are affected by dissolution, adsorption, and partitioning. Partitioning refers to the ratio of component found in a saturated vapor above an aqueous solution to the amount in the solution; this can, in theory, be calculated using the Henry's Law constants. Contaminants can also be adsorbed onto inorganic soil components or "dissolved" in organic components. These factors can result in a lowering of the partitioning coefficient.

Soil "tightness" or amount of void space in the soil matrix, will affect the rate of recharging of gas into the soil gas well.

Existence of a high, or perched, water table, or of an impermeable underlying layer (such as a clay lens or layer of buried slag) may interfere with sampling of the soil gas. Knowledge of site geology is useful in such situations, and can prevent inaccurate sampling.

4.4 Soil Probe Clogging

A common problem with this sampling method is soil probe clogging. A clogged probe can be identified by using an in-line vacuum gauge or by listening for the sound of the pump laboring. This problem can usually be eliminated by using a wire cable to clear probe (see Section 7.1.3.).

4.5 Underground Utilities

Prior to selecting sample locations, an underground utility search is recommended. The local utility companies can be contacted and requested to mark the locations of their underground lines. Sampling plans can then be drawn up accordingly. Each sample location should also be screened with a metal detector or magnetometer to verify that no underground pipes or drums exist.

5.0 EQUIPMENT/APPARATUS

5.1 Slam Bar Method

- Slam Bar (1 per sampling team).
- Soil gas probes, stainless steel tubing, 1/4" O.D., 5 ft length.
- Flexible wire or cable used for clearing the

- tubing during insertion into the well.
- "Quick Connect" fittings to connect sampling probe tubing, monitoring instruments, and Gilian pumps to appropriate fittings on vacuum box.
- Modeling clay.
- Vacuum box for drawing a vacuum around Tedlar bag for sample collection (1 per sampling team).
- Gilian pump Model HFS113A adjusted to approximately 3.0 L/min (1 to 2 per sample team).
- 1/4" Teflon tubing, 2 ft to 3 ft lengths, for replacement of contaminated sample line.
- 1/4" Tygon tubing, to connect Teflon tubing to probes and quick connect fittings.
- Tedlar bags, 1.0 L, at least 1 bag per sample point.
- Soil Gas Sampling labels, field data sheets, logbook, etc.
- PID/FID, or other field air monitoring devices, (1 per sampling team).
- Ice chest, for carrying equipment and for protection of samples (2 per sampling team).
- Metal detector or magnetometer, for detecting underground utilities/pipes/drums (1 per sampling team).
- Photovac GC, for field-lab analysis of bagged samples.
- Summa canisters (plus their shipping cases) for sample, storage and transportation.
- Large dark plastic garbage bags

5.2 Power Hammer Method

- Bosch demolition hammer.
- 1/2" O.D. steel probes, extensions, and points.
- Dedicated aluminum sampling points.
- Teflon tubing, 1/4".
- "Quick Connect" fittings to connect sampling probe tubing, monitoring instruments, and Gilian pumps to appropriate fittings on vacuum box.
- Modeling clay.
- Vacuum box for drawing a vacuum around Tedlar bag for sample collection (1 per sampling team).
- Gilian pump Model HFS113A adjusted to approximately 3.0 L/min (1 to 2 per sample team).
- 1/4" Teflon tubing, 2 ft to 3 ft lengths, for

- replacement of contaminated sample line.
- 1/4" Tygon tubing, to connect Teflon tubing to probes and quick connect fittings.
- Tedlar bags, 1.0 L, at least 1 bag per sample point.
- Soil Gas Sampling labels, field data sheets, logbook, etc.
- HNu Model P1101, or other field air monitoring devices, (I per sampling team).
- Ice chest, for carrying equipment and for protection of samples (2 per sampling team).
- Metal detector or magnetometer, for detecting underground utilities/pipes/drums (1 per sampling team).
- Photovac GC, for field-lab analysis of bagged samples.
- Summa canisters (plus their shipping cases) for sample, storage and transportation.
- Generator w/extension cords.
- High lift jack assembly for removing probes.

5.3 GeoprobeTM Method

The Geoprobe is a hydraulically-operated sampling device mounted in a customized four-wheel drive vehicle. The sampling device can be deployed from the truck and positioned over a sample location. The base of the sampling device is positioned on the ground. The weight of the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven past some dense stratigraphic horizons. When the probe reaches the sample depth, up to 50 feet under favorable geologic situations, samples can be collected.

Soil gas can be collected from specific depths in two general ways. One method involves withdrawing a sample directly from the probe rods, after evacuating a sufficient volume of air from the probe rods. The other method involves collecting a sample through tubing attached by an adaptor to the bottom probe rod section. Correctly used, this method provides more reliable results. Manufacturer's instructions and the SOP for the Model 5400 GeoprobeTM Operation should be followed when using this method.

6.0 REAGENTS

 PID/FID or calibration gases for field air monitoring devices (such as methane and

- isobutylene).
- Deionized organic-free water, for decontamination.
- Methanol, HPLC grade, for decontamination.
- Ultra-zero grade compressed air, for field blanks.
- Standard gas preparations for Photovac GC calibration and Tedlar bag spikes.
- Propane Torch (for decontamination of steel probes)

7.0 PROCEDURES

7.1 Soil Gas Well Installation

- 1. Initially a hole slightly deeper than the desired depth is made. For sampling up to 5 feet, a 5-ft single piston slam bar is used. For deeper depths, a piston slam bar with threaded 4-foot-long extensions can be used. Other techniques can be used, so long as holes are of narrow diameter and no contamination is introduced.
- 2. After the hole is made, the slam bar is carefully withdrawn to prevent collapse of the walls of the hole. The soil gas probe is then inserted.
- 3. It is necessary to prevent plugging of the probe, especially for deeper holes. A metal wire or cable, slightly longer than the probe, is placed in the probe prior to inserting into the hole. The probe is inserted to full depth, then pulled up three to six inches, then cleared by moving the cable up and down. The cable is removed before sampling.
- 4. The top of the sample hole is sealed at the surface against ambient air infiltration by using modeling clay molded around the probe at the surface of the hole.
- 5. If conditions preclude hand installation of the soil gas wells, the power driven system may be employed. The generator powered demolition hammer is used to drive the probe to the desired depth (up to 12 Ft may be attained with extensions). The probe is pulled up 1-3 inches if the retractable point is used. No clay is needed to seal the hole. After sampling, the probe is retrieved using

the high lift jack assembly.

6. If semi-permanent soil gas wells are required, the dedicated aluminum probe points are used. These points are inserted into the bottom of the power driven probe and attached to the Teflon tubing. The probe is inserted as in step 5. When the probe is removed, the point and Teflon tube remain in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.2 Screening with Field Instruments

- 1. The well volume <u>must</u> be evacuated prior to sampling. Connect the Gilian pump, adjusted to 3.0 L/min, to the sample probe using a section of Teflon tubing as a connector. The pump is turned on, and a vacuum is pulled through the probe for approximately 15 seconds. Longer time is required for sample wells of greater depths.
- 2. After evacuation, the monitoring instrument(s) (i.e. HNu or OVA) is connected to the probe using a Teflon connector. When the reading is stable, or peaks, the reading is recorded on soil gas data sheets.
- 3. Of course, readings may be above or below the range set on the field instruments. The range may be reset, or the response recorded as a greater than or less than figure. Recharge rate of the well with soil gas must be considered when resampling at a different range setting.

7.3 Tedlar Bag Sampling

- 1. Follow step 7.2.1 to evacuate well volume. If air monitoring instrument screening was performed prior to sample taking, evacuation is not necessary.
- Use the vacuum box and sampling train (Figure 1) to take the sample. The sampling train is designed to minimize the introduction of contaminants and losses due to adsorption. All wetted parts are either Teflon or stainless steel. The vacuum is drawn indirectly to avoid contamination from sample pumps.

- 3. The Tedlar bag is placed inside the vacuum box, and attached to the sampling port. The sample probe is attached to the sampling port via Teflon tubing and a "Quick Connect" fitting.
- 4. A vacuum is drawn around the outside of the bag, using a Gilian pump connected to the vacuum box evacuation port, via Tygon tubing and a "Quick Connect" fitting. The vacuum causes the bag to inflate, drawing the sample.
- 5. Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close valve. Record data on data sheets or in logbooks. Record the date, time, sample location ID, and the PID/FID instrument reading(s) on sample bag label.

CAUTION: Labels should not be pasted directly onto the bags, nor should bags be labeled directly using a marker or pen. Inks and adhesive may diffuse through the bag material, contaminating the sample. Place labels on the edge of the bags, or tie the labels to the metal eyelets provided on the bags. Markers with inks containing volatile organics (i.e., permanent ink markers) should not be used.

Chain of Custody Sheets must accompany all samples submitted to the field laboratory for analysis.

7.4 Tenax Tube Sampling

Samples collected in Tedlar bags may be adsorbed onto Tenax tubes for further analysis by GC/MS.

7.4.1 Additional Apparatus

- A. Syringe with a luer-lock tip capable of drawing a soil gas or air sample from a Tedlar bag onto a Tenax/CMS sorbent tube. The syringe capacity is dependent upon the volume of sample begin drawn onto the sorbent tube.
- B. Adapters for fitting the sorbent tube between the Tedlar bag and the sampling syringe. The adapter attaching the Tedlar bag to the sorbent tube consists of a reducing union (1/4" to 1/16" O.D. -- Swagelok cat. #

SS-400-6-ILV or equivalent) with a length of 1/4" O.D. Teflon tubing replacing the nut on the 1/6" (Tedlar bag) side. A 1/4" I.D. silicone O-ring replaces the ferrules in the nut on the 1/4" (sorbent tube) side of the union.

The adapter attaching the sampling syringe to the sorbent tube consists of a reducing union (1/4" to 1/16" O.D. -- Swagelok Cat. # SS-400-6-ILV or equivalent) with a 1/4" I.D. silicone O-ring replacing the ferrules in the nut on the 1/4" (sorbent tube) side and the needle of a luer-lock syringe needle inserted into the 1/16" side. (Held in place with a 1/16" ferrule.) The luer-lock end of the needle can be attached to the sampling syringe. It is useful to have a luer-lock on/off valve situated between the syringe and the needle.

C. Two-stage glass sampling cartridge (1/4" O.D. x 1/8" I.D. x 5 1/8") contained in a flame-sealed tube (Manufacturer: Supelco Custom Tenax/Spherocarb Tubes) containing two sorbent sections retained by glass wool:

Front section: 150 mg of Tenax-GC
Back section: 150 mg of CMS (Carbonized
Molecular Sieve)

These tubes are prepared and cleaned in accordance with EPA Method EMSL/RTP-SOP-EMD-013 by the vendor. The vendor sends ten tubes per lot made to the REAC GC/MS Laboratory and they are tested for cleanliness, precision, and reproductability.

- D. Teflon-capped culture tubes or stainless steel tube containers for sorbent tube storage and shipping. These containers should be conditioned by baking at 120 degrees C for at least two hours. The culture tubes should contain a glass wool plug to prevent sorbent tube breakage during transport. Reconditioning of the containers should occur between uses or after extended periods of disuse (i.e., two weeks or more).
- E. Nylon gloves or lint-free cloth. (Hewlett Packard Part # 8650-0030 or equivalent.)

7.4.2 Sample Collection

Handle sorbent tubes with care, using nylon gloves (or other lint-free material) to avoid contamination.

Immediately before sampling, break one end of the sealed tube and remove the Tenax cartridge.

Connect the valve on the Tedlar bag to the sorbent tube adapter. Connect the sorbent tube to the sorbent tube adapter with the Tenax (white granular) side of the tube facing the Tedlar bag. Connect the sampling syringe assembly to the CMS (black) side of the sorbent tube. Fittings on the adapters should be finer-tight. Open the valve on the Tedlar bag. Open the on/off valve of the sampling syringe. Depending on work plan stipulations, at least 10% of the soil gas samples analyzed by this GC method must be submitted for confirmational GC/MS analysis (according to modified methods TO-1 [Tenax absorbent] and TO-2 [Carbon Molecular Sieve (CMS) absorbent]). Each soil gas sample must be absorbed on replicate Tenax/CMS tubes. The volume absorbed on a Tenax/CMS tube is dependent on the total concentration of the compounds measured by the photovac/GC or other applicable GC:

Total Concentration (ppm)	Sample Volume (mL)
>10	Use Serial Dilution
10	10 - 50

5 20-100 1 100-250

After sampling, remove the tube from the sampling train with gloves or a clean cloth. DO NOT LABEL OR WRITE ON THE TENAX/CMS TUBE.

Place the sorbent tube in a conditioned stainless steel tube holder or culture tube. Culture tube caps should be sealed with Teflon tape.

7.4.3 Sample Labeling

Each sample tube container (not tube) must be labeled with the site name, sample station number, date sampled, and volume sampled.

Chain of custody sheets must accompany all samples to the laboratory.

7.4.4 Quality Assurance (QA)

Before field use, a QA check should be performed on each batch of sorbent tubes by analyzing a tube by thermal desorption/cryogenic trapping GC/MS.

At least one blank sample must be submitted with each set of samples collected at a site. This trip blank must be treated the same as the sample tubes except no sample will be drawn through the tube.

Sample tubes should be stored out of UV light (i.e., sunlight) and kept on ice until analysis. Samples should be taken in duplicate, when possible.

7.5 Summa Canister Sampling

- 1. Follow step 7.2.1 to evacuate well volume. If PID/FID readings were taken prior to taking a sample, evacuation is not necessary.
- 2. Attach a certified clean, evacuated 6-liter Summa canister via the 1/4" Teflon tubing.
- 3. Open valve on Summa canister. The soil gas sample is drawn into the canister by pressure equilibration. The approximate sampling time for a 6 liter canister is 20 minutes.
- 4. Site name, sample location, number, and date must be recorded on a chain of custody form and on a blank tag attached to the canister.

8.0 CALCULATIONS

8.1 Field Screening Instruments

Instrument readings are usually read directly from the meter. In some cases, the background level at the soil gas station may be subtracted:

Final Reading = Sample Reading - Background

8.2 Photovac GC Analysis

Calculations used to determine concentrations of individual components by Photovac GC analysis are beyond the scope of this SOP and are covered in ERT SOP #2109, Photovac GC Analysis for Soil Water and Air/Soil Gas.

9.0 CALIBRATION

9.1 Field Instruments

It is recommended that the manufacturers' manuals be consulted for correct use and calibration of all instrumentation.

9.2 Gilian Model HFS113A Air Sampling Pumps

Flow should be set at approximately 3.0 L/min; accurate flow adjustment is not necessary. Pumps should be calibrated prior to bringing into the field.

10.0 QUALITY ASSURANCE/ QUALITY CONTROL

10.1 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe via a Gilian pump and checking the response of the FID/PID. If readings are higher than background, replacement or decontamination is necessary.

Sample probes may be decontaminated simply by drawing ambient air through the probe until the HNu reading is at background. More persistent contamination can be washed out using methanol and water, then air drying. For persistent volatile contamination, use of a portable propane torch may be needed. Using a pair of pliers to hold the probe, run the torch up and down the length of the sample probe for approximately 1-2 minutes. Let the probe cool before handling. When using this method, make sure to wear gloves to prevent burns. Having more than one probe per sample team will reduce lag times between sample stations while probes are decontaminated.

10.2 Sample Train Contamination

The Teflon line forming the sample train from the probe to the Tedlar bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it should be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a Gilian pump, for approximately 30 seconds between each sample. After purging, the

sampling train can be checked using an FID or PID, or other field monitoring device, to establish the cleanliness of the Teflon line.

10.3 FID/PID Calibration

The FID and PIDs should be calibrated at least once a day using the appropriate calibration gases.

10.4 Field Blanks

Each cooler containing samples should also contain one Tedlar bag of ultra-zero grade air, acting as a field blank. The field blank should accompany the samples in the field (while being collected) and when they are delivered for analysis. A fresh blank must be provided to be placed in the empty cooler pending additional sample collection. One new field blank per cooler of samples is required. A chain of custody sheet must accompany each cooler of samples and should include the blank that is dedicated to that group of samples.

10.5 Trip Standards

Each cooler containing samples should contain a Tedlar bag of standard gas to calibrate the analytical instruments (Photovac GC, etc.). This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. A chain of custody sheet should accompany each cooler of samples and should include the trip standard that is dedicated to that group of samples.

10.6 Tedlar Bag Check

Prior to use, one bag should be removed from each lot (case of 100) of Tedlar bags to be used for sampling and checked for possible contamination as follows: the test bag should be filled with ultra-zero grade air; a sample should be drawn from the bag and analyzed via Photovac GC or whatever method is to be used for sample analysis. This procedure will ensure sample container cleanliness prior to the start of the sampling effort.

10.7 Summa Canister Check

From each lot of four cleaned Summa canisters, one is to be removed for a GC/MS certification check. If the canister passes certification, then it is re-evacuated and all four canisters from that lot are available for sampling.

If the chosen canister is contaminated, then the entire lot of four Summas must be recleaned, and a single canister is re-analyzed by GC/MS for certification.

10.8 Options

10.8.1 Duplicate Samples

A minimum of 5% of all samples should be collected in duplicate (i.e., if a total of 100 samples are to be collected, five samples should be duplicated.) In choosing which samples to duplicate, the following criteria applies: if, after filling the first Tedlar bag, and, evacuating the well for 15 seconds, the second HN (or other field monitoring device being used) reading matches or is close to (within 50%) the first reading, a duplicate sample may be taken.

10.8.2 Spikes

A Tedlar bag spike and Tenax tube spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (landfills, etc.). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. Summa canisters containing samples are not spiked.

11.0 DATA VALIDATION

11.1 Blanks (Field and Tedlar Bag Check)

For each target compound, the level of concentration found in the sample must be greater than three times the level (for that compound) found in the field blank which accompanied that sample to be considered valid. The same criteria apply to target compounds detected in the Tedlar bag pre-sampling contamination check.

12.0 HEALTH AND SAFETY CONSIDERATIONS

Due to the remote nature of sampling soil gas, special considerations can be taken with regard to health and safety. Because the sample is being drawn from underground, and no contamination is introduced into the breathing zone, soil gas sampling usually occurs in Level D. Ambient air is constantly monitored using the HNu PI101 to obtain background readings during the sampling procedure. As long as the levels in ambient air do not rise above background, no upgrade of the level of protection is needed.

When conducting soil gas sampling, leather gloves should be worn, and proper slam bar techniques should be implemented (bend knees). Also, an underground utility search should be performed prior to sampling. (See Section 4.5).

13.0 REFERENCES

Gilian Instrument Corp., Instruction Manual for Hi Flow Sampler: HFS113, HFS 113 T, HFS 113U, HFS 113 UT, 1983.

HNu Systems, Inc., Instruction Manual for Model PI 101 Photoionization Analyzer, 1975.

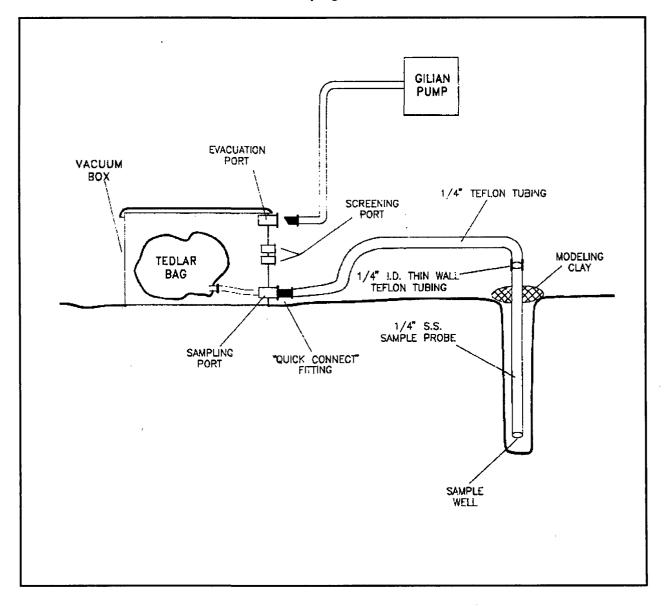
N.J.D.E.P., Field Sampling Procedures Manual, Hazardous Waste Programs, February, 1988.

Roy F. Weston, Inc., Weston Instrumentation Manual, Volume I. 1987.

U.S.E.P.A., Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, 2nd Edition, EPA-600/4-84-076, December, 1984.

APPENDIX A

FIGURE 1. Sampling Train Schematic



APPENDIX B

HNu Field Protocol

Field Procedure

The following sections detail the procedures that are to be followed when using the HNu in the field.

Startup Procedure

- a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug in; don't force.
- b. Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery are on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging.
- c. Turn the function switch to any range setting. Look into the end of the probe for no more than two to three seconds to see if the lamp is on. If it is on, it will give a purple glow. Do not stare into the probe any longer than three seconds. Long term exposure to UV light can damage eyes. Also, listen for the hum of the fan motor.
- d. To ZERO the instrument, turn the function switch to the standby position and rotate the zer o adjustment until the meter reads zero. A calibration gas is not needed since this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero.

Operational Check

- a. Follow the startup procedure.
- b. With the instrument set on the 0-20 range, hold a solvent-based major market near the probe tip. If the meter deflects upscale, the instrument is working.

Field Calibration Procedure

- a. Follow the startup procedure and the operational check.
- b. Set the function switch to the range setting for the concentration of the calibration gas.
- c. Attach a regulator (HNu 101-351) to a disposable cylinder of isobutylene gas (HNu 101-351). Connect the regulator to the probe of the HNu with a piece of clean Tygon tubing. Turn on the value on the regulator.
- d. After fifteen seconds, adjust the span dial until the meter reading equals the concentration of the calibration gas used. Be careful to unlock the span dial before adjusting it. If the span has to be set below 3.0, calibration internally or return to equipment maintenance for repair.

e. Record in the field logbook: the instrument ID no. (EPA decal or serial number if the instrument is a rental); the initial and final span settings; the date and time; concentration and type of calibration has used; and the name of the person who calibrated the instrument.

Operation

- a. Follow the startup procedure, operational check, and calibration check.
- b. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0-20 ppm range. Adjust it if necessary.
- c. While taking care not to permit the HNu to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the Site Health and Safety Plan.
- d. When the activity is completed or at the end of the day, carefully clean the outside of the HNu with a damp disposable towel to remove any visible dirt. Return the HNu to a secure area and place on charge.
- e. With the exception of the probe's inlet and exhaust, the HNu can be wrapped in clear plastic to prevent it form becoming contaminated and to prevent water from getting inside in the event of precipitation.



PHOTOVAC GC ANALYSIS FOR SOIL, WATER, AND AIR/SOIL GAS

SOP#: 2109 DATE: 10/19/94

REV. #: 0.0

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe a method for a low-cost field laboratory screening tool for tentative identification and determination of concentration levels on select contaminants for site assessment and health and safety surveys.

This method describes the rapid screening of air/soil gas, water, and soil samples using a Photovac portable Gas Chromatograph (GC) Model 10S series to determine the presence of various volatile organic compounds.

Data generated allows only rapid evaluation of site conditions and is applied to, but not limited to, the following activities: extent and degree of contamination; pollutant plume definition; health and assessment: and tentative safety identification and quantitation. The data should not be used for site ranking or enforcement purposes since only limited Quality Assurrance/Quality Control (QA/QC) is required, and the reported data is qualified as tentative.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations, or limitations imposed by the procedure or other procedure limitations. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement recommendation for use.

2.0 METHOD SUMMARY

Air/soil gas, water, or soil samples can be analyzed by the Photovac. Brief method summaries are provided below. All methods use a Photovac 10S series GC equipped with a 10.6 eV Photoionization Detector (PID), and use external standards to tentatively identify and quantitate compounds of interest.

2.1 Air/Soil Gas Samples

Ambient air or soil gas samples are collected in oneliter Tedlar bags. An aliquot of each bag sample is withdrawn using a gas-tight syringe and directly injected into the GC. Vapor from selected samples can then be absorbed onto Tenax/CMS cartridges for confirmational GC/MS analysis.

2.2 Water Samples

Water samples are collected in 40-mL VOA vials with Teflon-lined silicone septum screw caps. A 20-mL aliquot of sample is pipetted into a second, clean VOA vial. The vial is capped, shaken vigorously for one minute, and allowed to stand at room temperature for at least 30 minutes for vapor phase equilibration. An aliquot of the water headspace is then injected into the GC using a gas-tight syringe.

2.3 Soil Samples

Soil samples are collected in VOA vials. A five gram aliquot of sample is weighed into a second, clean vial. Enough reagent water is added to bring the total volume of the soil/water extract to 20-mL. The vial is then capped, shaken vigorously for one minute, and allowed to stand at room temperature for at least one hour for vapor phase equilibration. An aliquot of the soil headspace is then injected into the GC using a gas-tight syringe.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Air/Soil Gas Samples

Air/soil gas samples are collected and stored in one liter Tedlar gas sampling bags as per the Soil Gas Sampling SOP. Samples should be kept in a cooler out of direct light and heat. Samples should be analyzed within 48 hours of collection, preferably within 12 hours.

Alternatively, samples may be collected in Summa canisters. In this case, sample stability may extend up to two months, depending upon sample matrix.

3.2 Water Samples

Water samples are collected, in triplicate, in 40-mL VOA vials. One sample is to be analyzed by the Photovac; the two remaining vials are used for confirmation analysis by another method. All three should be completely filled, with no visible air bubbles. Samples are stored out of direct light, in a cooler packed with ice immediatly upon collection until analysis. Sample vials should be protected against breakage. Samples should be analyzed within seven days of collection.

3.3 Soil Samples

Soil samples are collected in 40-mL VOA vials, and stored out of direct light, in a cooler packed with ice. Sample containers should be protected from breakage.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 Air/Soil Gas Samples

- High concentrations of short chain alkanes and alkenes in samples may interfere with the resolution and detector sensitivity of early-eluting chlorinated alkenes and aromatic compounds.
- 2. Syringe blanks should be run as necessary to ensure against carryover contamination.
- 3. Samples can be contaminated by diffusion of

volatile organics through the septum seals and the walls of the sampling bag during shipment and storage. A field blank, a Tedlar bag filled with ultra-zero air carried through sampling and handling protocol can serve as a check on such contamination.

- 4. Teflon or equivalent inert fittings and tubing should be used in all procedures to prevent contamination by off-gassing.
- 5. Parameters are identified by retention time (RT). Samples with response at the same RTs as target compounds are assumed to be identical, which may not be the case.

4.2 Water and Soil Samples

- 1. Liquid samples can not be directly introduced into the GC. Direct injection of liquids, without heated injection ports, may result in damage to the GC.
- 2. Syringe blanks should be run as necessary to ensure against carryover contamination.
- Samples can be contaminated by diffusion of volatile organics through the septum seal during shipment and storage. A field reagent blank, prepared from reagent water and carried through the sampling and handling protocol, can serve as a check on such contamination.
- 4. Some of the sample will volatilize when the vials are opened during sample preparation. This loss is minimized by proper sample handling.
- 5. Parameters are identified by retention time (RT). Samples with response at the same RTs as target compounds are assumed to be identical, which may not be the case.

5.0 EQUIPMENT/APPARATUS

The following equipment is required for Photovac operation and analysis.

5.1 Photovac Operation

 Photovac 10S Series Gas Chromatograph, with manual and power cord

- Extra source lamp
- Photovac lamp-tuning screwdriver
- Extra columns/fittings
- Ultra-zero-air carrier gas
- Two stage regulator, with quick-connect fitting
- One flowmeter per Photovac, either bubblemeter, rotameter, or Gilibrator
- Septa, six-mm diameter
- Syringes, gas-tight, 10 μl to 1 mL
- VOA vials filled with activated charcoal (for syringe cleaning)
- Extra Photovac integrator pens
- Extra Photovac integrator paper
- Labels
- Tools Large adjustable wrench
 - wrenches (5/16" to 9/16")
 - screwdrivers (flat head and Phillips head)
 - nosepliers
 - jeweler's screwdrivers
 - Allen wrenches
- Duct tape
- Teflon tape
- Power strip
- Snoop
- Kimwipes
- Pelican cases

5.2 Soil Gas Analysis

• Tedlar bags, one liter

- Summa canisters for holding gas standards
- Extra-large syringe (100 mL to 500 mL) for serial dilutions

5.3 Tenax/CMS Sampling

- Tenax/CMS cartridges in sealed, glass ampoules
- Culture tubes (labeled) with glass wool to ship cartridges
- Cotton gloves or cloths for cartridge handling
- Fitting to connect syringe to cartridge
- Fitting to connect cartridge to Tedlar bag
- 1/4" silicone O-rings for a tight seal around cartridge

5.4 Water Headspace Analysis

- Headspace standards, Purgeable A and B or equivalent
- 1.8-mL vials for holding standards (either screw-cap or crimp-top vials)
- Pasteur pipettes for transferring standards
- 40-mL VOA vials (one per sample plus extras for standards and QA/QC requirements)
- 10-mL or 20-mL pipettes and pipette bulb
- Liquid standard syringes
- Surgical gloves

5.5 Soil Headspace Analysis

- Same equipment for Water Headspace Analysis, plus:
- Portable scale, accurate to ± 0.1 g.
- Spatulas, or equivalent, for transferring soil

6.0 REAGENTS

6.1 Reagent List for Air Sample Analysis

- Gas Standards Certified to ±2% level of accuracy, commercially available through Scott Specialty Gas or equivalent. In-house laboratory preparation of calibration gas standards with confirmational GC/MS analysis is acceptable.
- 2. Ultra-zero air carrier gas.

6.2 Reagent List for Water and Soil Sample Analysis

- 1. Reagent Water Organic-free chromatographic grade or equivalent, free of any contaminants which may interfere with the detection and resolution of target parameters.
- 2. Ultra zero air carrier gas.
- 3. Stock Standard Solutions Stock standard solutions may be prepared from pure standard materials or purchased as certified solutions (e.g., Supelco Purgeable A or B, or equivalent). Reagents to be used as standards may be dependent upon site specific suspected volatile contaminants.

7.0 PROCEDURES

7.1 Method Detection Limits

The method detection limit (MDL) is determined just before the analysis with a serial dilution of the standard, and is the lowest concentration that can be detected at the gain setting selected for the analysis. MDLs are dependent on the type of analysis performed and the condition of the gas chromatograph. Because of the difference in matrices, air and soil gas analyses usually have MDLs an order of magnitude above headspace analyses. Factors that can vary the sensitivity of a Photovac from site to site are the age of the source lamp, detector age, column condition, shipping the GC to the site, and the location of the field lab. Typical MDLs for soil gas range from 10 ppb to 50 ppb, and headspace MDLs range from

1 ppb to 5 ppb.

If sample concentrations are high, injection volumes may be reduced to obtain on-scale response for parameters of interest, and to avoid contamination of the GC system. The method detection limit (MDL) for compounds not detected at reduced injection volumes is calculated by the following:

$$MDL = \frac{(V_{STD})(C_{STD})}{(V)}$$
 (Equation 1)

where,

 V_{STD} = Lowest volume of standard

headspace injected

 C_{STD} = Concentration of standard

V = Volume of sample headspace

injected

7.2 Calibration

Photovac analyses are calibrated by the external standard method using the standards described in Section 6. At the beginning of the analysis, a three-to-five point calibration curve is run to demonstrate linear instrument response over a specified concentration range. The development of this method has shown the best linearity of the PID response to be from 10 ppb to 1 ppm for air/soil gas analysis and from 1 ppb to 100 ppb for headspace analysis. Most PIDs will be linear above that range but eventually at high enough concentrations the PID will become saturated. The curve is verified daily by running a calibration check standard from the middle of the curve.

If the response of any parameter varies from the curve by more than ±25% RSD (relative standard deviation) indicating that the instrument response has changed, then a new calibration curve should be run.

1. Air/Soil Gas Calibration

The concentrations needed for calibration can be prepared by a serial dilution of the gas standard. For example, adding 50 mL of a 1-ppm standard and 450 mL of ultra zero carrier gas to a new Tedlar bag gives a 100-ppb calibration standard. The 100 ppb bag can then be used to make up lower

concentration standards.

Alternatively, the analyst can construct a calibration curve by varying injection volumes. By designating a 250- μ L injection volume as the 1-ppm standard, a 100-ppb standard is created by injecting 25 μ L of a 1-ppm standard. This method is more convenient and does not require the large syringes needed for serial dilution, but it has the limitation that the calibration curve is limited by the sizes of the available syringes.

2. Water and Soil Calibration

Headspace standards can be created at selected concentrations by adding the appropriate volumes of stock standard into clean 40-mL VOA vials containing 20 mL of reagent water. These volumes (V) are calculated by:

$$V = \frac{20 \ mL}{(Calibrant \ conc.)} \times (Stock \ conc.)$$

(Equation 2)

From the 200-ppm Purgeable A and B standards, it is advisable to first prepare a 2-ppm stock solution to allow calibration standards between 1 ppb and 10 ppb to be prepared with the syringes listed in Section 5.

7.3 Operation

7.3.1 Air/Soil Gas Analysis

- 1. Typical columns used for this method include SE-30 (packed) and CP-Sil 19 (capillary). An example of compound separation using CP-Sil 19, with typical chromatographic conditions, is shown in Figure 1 (Appendix A).
- 2. Standards are injected after every 10-15 samples or every six hours, whichever is more frequent, to bracket possible parameter RT variations.
- 3. If sample concentrations are high, injection volumes may be reduced to obtain on-scale response. The method detection limit (MDL)

for compounds not detected at reduced injection volumes is calculated according to Equation 1, in Section 7.1.

4. Identify the compounds in the sample by comparing the retention time (RT) of the peaks in the sample chromatogram with those of the peaks in the standard chromatograms. The width of the RT windows used to make identifications should be based upon measurements of actual RT variations of standards which bracket a series of sample injections. Three times the standard deviation of a RT can be used to calculate a suggested window size, however, the experience of the analyst should be a major factor in the interpretation of chromatograms.

7.3.2 Water Sample Analysis

- 1. Pipet a 20-mL aliquot of sample into a clean 40-mL VOA vial with Teflon-lined septum screw cap. Cap the vial.
- 2. Shake the capped vial vigorously by hand for one minute. Allow to stand, inverted, and undisturbed for at least 30 minutes at ambient temperature for vapor phase equilibration. Use a gas-tight syringe to extract an aliquot of headspace by inserting the syringe needle through the vial septum to a distance approximately half way between the liquid surface and the septum's Teflon face. Purge the syringe barrel three to five times by withdrawing and expelling a volume of headspace in slight excess of the volume anticipated to be used for analysis.
- 3. If sample concentrations are high, injection volumes may be reduced to obtain on-scale response. If sample headspace injection volume is reduced below the volume of the aqueous calibration standard used to establish the MDL, the detection limit for target compounds detected at the reduced headspace volume must be determined. This is accomplished by injecting headspace aliquots at the reduced volume into the GC, beginning with the 10-ppb calibration standard and increasing or decreasing standard concentrations as warranted until a

response has been obtained for all target compounds. The detection limit for parameters detected at the lower headspace injection volume is then calculated using Equation 1, Section 7.1.

4. Identify the compounds in the sample by comparing the RT of the peaks in the sample chromatogram with those of the peaks in standard chromatograms. The width of the RT windows used to make identifications should be based upon measurements of actual RT variations of standards over the course of a day. Three times the standard deviation of a RT can be used to calculate a suggested window size, however, the experience of the analyst should be a major factor in the interpretation of chromatograms.

7.3.3 Soil Sample Analysis

- Place a clean, empty, 40-mL, glass vial on the balance. Zero the balance. Use a clean stainless steel spatula to add 5.0 g ±0.1 g of soil sample. Pipet enough reagent water to bring the total volume of the soil and water to 20 mL. Seal the vial with a Teflon-lined, septum screw cap.
- 2. Shake the capped vial vigorously for one minute to promote dispersion of the soil sample and increase surface area. Allow to stand, undisturbed, at ambient temperature for at least one hour for vapor phase equilibrium. Use a gas-tight syringe to extract an aliquot of headspace by inserting the syringe needle through the vial septum to a distance approximately half way between the slurry surface and the septum's Teflon face. Purge the syringe barrel three to five times by withdrawing and expelling a volume of headspace in slight excess of the volume anticipated to be used for analysis. Wipe the syringe needle with a kimwipe before injection into the GC.
- 3. Although 5g has worked the best for most soil matrices, other amounts ranging from 1-10g have also been used depending on sample concentrations and the consistency of the matrix.

- 4. If sample concentrations are high, the analyst can either reduce the injection volumes or analyze less soil to obtain on-scale response. If sample headspace injection volume is reduced below the volume of aqueous calibration standard used to establish the MDL, follow the procedure in Section 7.2.3 to determine the MDL for target compounds detected at the reduced headspace volume. Alternatively, the analyst can weigh out as little as 1.0 g, keeping in mind that this means a 10% error if using a portable balance accurate to ±0.1 g.
- 5. Identify the parameters in the sample by comparing the RT of the peaks in the sample chromatogram with those of the peaks in standard chromatograms. The width of the RT windows used to make identifications should be based upon measurements of actual RT variations of standards over the course of a day. Three times the standard deviation of a RT can be used to calculate a suggested window size, however, the experience of the analyst should be a major factor in the interpretation of chromatograms.

8.0 CALCULATIONS

8.1 Air/Soil Gas Samples

The concentration of individual compounds in each sample is determined by using the following equation:

$$[Sample] = \frac{(Area \ Sample)}{(Area \ Standard)} \times \frac{(Volume \ Standard)}{(Volume \ Sample)} \times [Standard]$$

(Equation 3)

"Area Standard" is the average of the areas of the standards run before and after the sample. Concentrations are reported in ppb or ppm (volume/volume).

8.2 Water Samples

Concentrations of individual compounds in the sample are determined by the following equation:

This is the same as Equation 3, except the concentration of the headspace standard is used. Concentrations are reported in μ g/L (ppb).

8.3 Soil Samples

Concentrations of individual compounds in the sample are determined by the following equation:

The volume of the headspace is always 20 mL, and the weight of the sample is usually 5 g. Concentrations are reported in $\mu g/kg$ (ppb).

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

In order to meet the QA2 data quality objectives, at least 10% of all field samples must be confirmed by GC/MS analysis. The following QA/QC requirements must be followed and provided in the data package submitted:

- 1. Chain of custody documentation.
- Sample log, including date/time of sample collection, date/time of analysis, and run numbers.

3. Blanks

- 1. Air/Soil Gas Analysis For each day of analysis, Field Standards (Tedlar bags filled with gas standards) and Field Blanks (Tedlar bags filled with ultra-zero air) must accompany samples through collection, handling, and storage.
- 2. Water Analysis Field Blank duplicate 40-mL VOA vials completely filled with reagent water must accompany each cooler used for sample collection, storage, and/or shipment.
- Soil Analysis Reagent Blank -20 mL of the reagent water used in the soil analysis is pipetted into a clean 40-mL VOA vial, allowed to equilibrate, and analyzed prior to sample analysis.

$$[Sample] = \frac{(Area\ Sample)}{(Area\ Standard)} \times \frac{(Volume\ Standard)}{(Volume\ Sample)} \times [Standard]$$
(Equation 4)

4. Instrument calibration data

$$[Sample] = \frac{(Area\ Sample)}{(Area\ Standard)} \times \frac{(Vol.\ Standard)}{(Vol.\ Sample)} \times \frac{(Vol.\ Headspace)}{(Weight\ Sample)} \times [Standard]$$
(Equation 5)

- 5. Syringe blanks Syringe blanks are to be run prior to each sample analysis. (In practice, there is no need to run syringe blanks if the previous sample is clean).
- 6. Labeling of chromatograms Each chromatogram must be clearly identified by analysis type (i.e., syringe blank, sample number, or calibrant concentration), injection volume, run number, date, and time.
- 7. Replicate analysis A replicate sample analysis is to be run after every 10 samples to check method/analyst precision. The RSD of the area response of any of the compounds should be within 15%.
- 8. Retention time/instrument response check Since compound identification is based upon RT matches, a calibration standard should be run after every 10-15 samples.
- 9. Spikes Soil and Water Samples Only
 - 1. For every 20 samples, one Matrix Spike (MS) and one Matrix Spike Duplicate (MSD) must be analyzed. If there are less than 20 samples in a matrix, at least one MS/MSD must be analyzed.
 - 2. The spiked samples should, if possible, have moderate concentrations. The amount spiked should be equivalent to the middle of the calibration range, or one to five times the sample background concentrations, whichever is higher.

3. To calculate the percent recovery (%R) of each compound of interest:

$$R = 100\% \times \frac{(A - B)}{S}$$
 (Equation 6)

where,

A	=	concentration	of	sample
		and spike		

B = concentration of sample

S = concentration of the spike

- 4. The %R should be 50-90% for a soil matrix, and 80-120% for a water matrix. Due to the complexity of the soil/water/vapor equilibria, recoveries from soil matrices are consistently below 100%.
- 5. After the analysis of at least three spiked water samples, calculate the average percent recovery (P_{avg}) and the standard deviation of percent recovery (S_p). Express the accuracy assessment as the percent recovery interval, from P_{avg}-(w)s p to P_{avg}+(2)s_p. Update the accuracy assessment for each parameter at each site where at least three accuracy measurements are made. This step is optional.

10. Confirmational Analysis (Air/Soil Gas)

Depending on work plan stipulations, at least 10% of the soil gas samples analyzed by this GC method must be submitted for confirmational GC/MS analysis (according to modified methods TO-1 [Tenax absorbent] and TO-2 [Carbon Molecular Sieve (CMS) absorbent]). Each soil gas sample must be absorbed on replicate Tenax/CMS tubes. The volume absorbed on a Tenax/CMS tube is dependent on the total concentration of the compounds measured by the Photovac:

Sample Volume (mL)
Use Serial Dilution
10-50
20-100
100-250

A range of volumes is given to account for sample variability. The low end of the range should be used for samples whose total concentrations are primarily one large peak, as too large a volume will overload the GC/MS column when that peak is confirmed. The high end of the range should be used for multi-peak samples.

10.0 DATA VALIDATION

Data should be reviewed to ensure that the QA/QC requirements listed in Section 9 have been met.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow US EPA, OSHA, and corporate health and safety practices. More specifically, it is suggested that the samples should be stored in a cooler, away from the analysis area. In addition, the analysis area should have adequate ventilation.

12.0 REFERENCES

EPA Method 601/602.

FASP Method 101, <u>Screening for Volatile Organics in</u> Water.

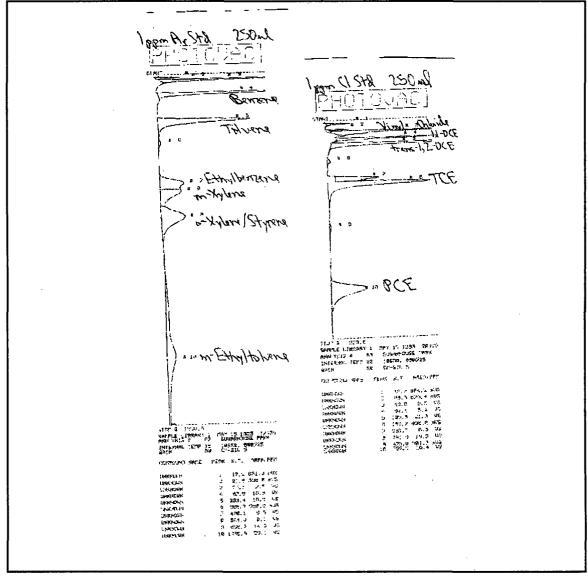
Chapman, H., Clay, P., Field Investigation Team (FIT) Screening Methods and Mobile Laboratories Complementary to Contract Laboratory Program (CLP), October 17, 1986.

APPENDIX A

Figures

FIGURE 1. Gas Chromatogram of Gas Standards Used in Air/Soil Gas Analysis

(10S50 GC Flow 10-15 cc/min Gain 50 Window 10% Min Area 100 mV/sec Chart Speed 0.5 cm/min Slope Sens. 18, 14, 4)

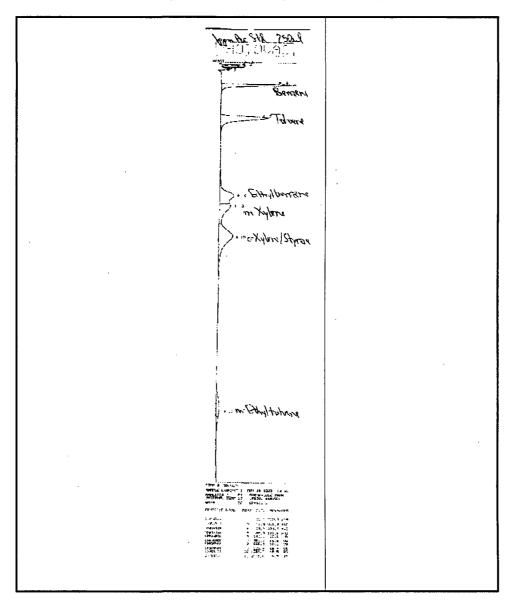


APPENDIX A (Cont'd)

Figures

FIGURE 2. Gas Chromatogram of Purgeable Standards Used in Water or Soil Analysis

(10S50 GC Flow 10-15 cc/min Gain 50 Window 10% Min Area 100 mV/sec Chart Speed 0.5 cm/min Slope Sens. 18, 14, 4)





AIR SAMPLING FOR METALS [NIOSH Method 7300, Elements]

SOP#: 2119 DATE: 10/07/94 REV. #: 0.0

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to define the proper sample collection technique for air sampling for elements (metals), as well as delineate the typical working range of the method and indicate potential interferences. Elements covered by this method include the metals listed in Table 1 (Appendix A).

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Air sampling for elements (metals) involves passing a known quantity of air across a mixed cellulose ester (MCE) filter. The particulate phase of the air, with a nominal size of greater than or equal to 0.8 microns (μm) , is trapped in the filter.

This method requires air sampling utilizing 37 millimeter (mm), 3-stage cassettes loaded with 0.8 um MCE filters and support pads. The approximate minimum and maximum sample volumes required for detection of the metals of interest are listed in Table 1 (Appendix A).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

No preservatives or special storage conditions are required. However, the samples should be stored with

the filter upright and transported at or near ambient conditions to prevent significant deterioration of the samples. When transporting and handling the samples, prevent impact and vibrations which would dislodge particulates from the filters.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

A potential problem with the sampling method is over-loading of the filter. This can disrupt flow, consequently producing falsely low analytical results. Periodic checking of the filter and pump can predict this condition and sample cassettes can be changed during the sampling period. The multiple filters would be analyzed as one sample with the total volume indicated on the Chain of Custody record.

5.0 EQUIPMENT/APPARATUS

The following equipment is required for air sampling for elements:

- Low or medium volume air pumps
- Tygon tubing
- 0.8 μm MCE filters with support pads
- 37 mm 3-stage cassettes
- Hose-barb filter adapters
- Air flow calibration standard (calibrated rotameter or bubble meter)
- Screw driver set
- Air Sampling Worksheets and sample labels
- Chain of Custody records
- Particulate monitoring equipment (RAM)
- Protective clothing
- Whirl bags

6.0 REAGENTS

This section is not applicable to this SOP.

7.0 PROCEDURE

7.1 Preparation

- 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.
- Obtain and organize the necessary sampling and monitoring equipment.
- 3. Decontaminate or pre-clean equipment, and ensure that it is in working order. Precalibrate sampling equipment, if possible.
- 4. Prepare scheduling and coordinate with staff, client, and regulatory agency, if appropriate.
- 5. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan.
- 6. Use stakes, flagging tape, or other appropriate means to mark all sampling locations. If necessary, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.
- 7. Make an estimate of the airborne concentrations of the elements of concern. It may be possible to extrapolate the concentration of particulates by assuming similar percentages of metals are present in the airborne particulates as in the soils. However, it should be noted that this is only a rough estimate. If estimation of the airborne concentration of metals is not possible, then sample volumes should remain within the limits recommended in Table 1 (Appendix A).
- 8. Arrange for sample analysis by an appropriately certified laboratory and check with the laboratory for any special requirements (e.g., additional lot blanks).

7.2 Calibration

Calibrate the required number of sampling pumps in the following manner:

1. Assemble the calibration train as shown in Figure 1 (Appendix A) using a representative

- 37 mm, 3-stage filter cassette loaded with a $0.8~\mu m$ MCE filter and support pad (outlet plug removed), tygon tubing, a hose-barb filter adapter, a rotameter, and an air sampling pump. Depending on the required flow rate, a low volume or a medium volume sampling pump may be required. Refer to Figure 2 (Appendix A) for an illustration of the components of the filter cassette.
- 2. Turn on the pump and adjust the flow using the flow adjust mechanism until the float ball on the rotameter is aligned with the rotameter's precalibrated flow rate value. A sticker on the rotameter should indicate this value.
- 3. Affix a sticker to the pump indicating flow rate and media.

7.3 Sampling

- 1. Assemble the sampling trains with clean filter cassettes (Figures 3 and 4, Appendix A).
- Verify the pump calibration by removing the inlet plug from the cassette, attaching a rotameter with Tygon tubing and turning on the sampling pump. Ensure that all connections are tight. Record the actual flow rate on the Air Sampling Worksheet. Replace the inlet plug until ready to sample.
- 3. Set the sampling pump timer (low volume pumps) for the appropriate sampling time as determined by the Work Assignment Manager, or record the elapsed timer readings (medium volume pumps) on the Air Sampling Worksheet. This will be dictated by the type of sampling pump being utilized.
- 4. Deploy the sampling pumps as indicated in the sampling plan, following site health and safety procedures.
- 5. Remove the cassette cap or inlet plug from the cassette. Sampling for elements can be conducted with the cassettes open-faced (cassette cap removed) or closed-faced (only inlet port plug removed). Open-faced is preferred because it permits an even loading of the filter cassette and should be used

whenever high particulate concentrations are expected. This allows greater particulate loading of the filter. However, either method is acceptable since the entire filter is used during sample analysis. Closed-faced sampling is typically performed when there is a possibility that the sample may be shaken and particulates may be lost.

 Turn on the sampling pump and allow it to run for the sampling period determined by the Work Assignment Manager.

7.4 Post Sampling

- 1. Verify the sampling period by reading the sample run time (low volume pumps) or by checking the elapsed time on the counter (medium volume pumps). Record the sampling time on the Air Sampling Worksheet and turn off the pump.
- 2. Verify the pump calibration by attaching a rotameter with Tygon tubing and turning on the sampling pump. Record the actual flow rate on the Air Sampling Worksheet. Insert the inlet plug.
- 3. Remove the sampling cassette from the sampling train and insert the outlet plug.
- 4. Complete the Air Sampling Worksheet and calculate the sample volume.
- 5. Label the sample and place it in a whirl bag for transport to the laboratory for analysis.
- Prepare the samples (including QC samples)
 for transport by packing them in a shipping
 container with bubble wrap or styrofoam
 pieces. Complete a Chain of Custody record
 in accordance with applicable Chain of
 Custody Procedures.

8.0 CALCULATIONS

The total volume of a sample is calculated by multiplying the total sample time by the flow rate. The total volume for each sample must be indicated on the Chain of Custody Record.

9.0 QUALITY ASSURANCE/

QUALITY CONTROL

The following general QA procedures apply:

1. All data must be documented on Air Sampling Worksheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

The following specific QC activities apply:

- 1. Provide one field blank per sampling event or per 20 samples, whichever is greater. The field blank should be handled in the same manner as the sampling cassette (remove/replace cap and plug, and transport) except that no air is drawn through it.
- 2. Collect one collocated sample per sampling event or per 10 samples, whichever is greater. Collocated samples are two samples collected adjacent to each other during the same time period at the same flow rates.
- 3. Include a minimum of two lot blanks per manufacturer's lot of sampling cassettes utilized per sampling event. Consult with the analytical laboratory to determine if additional lot blanks are required.

10.0 DATA VALIDATION

Results of the QA/QC samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, or corporate health and safety procedures.

12.0 REFERENCES

(1)NIOSH Manual of Analytical Methods, NIOSH Method 7300, Elements (ICP) (Issued 02/15/84).

APPENDIX A

Table

TABLE 1. Metal Concentrations are Anticipated to be at or Near the Threshold Limit Value (TLV)

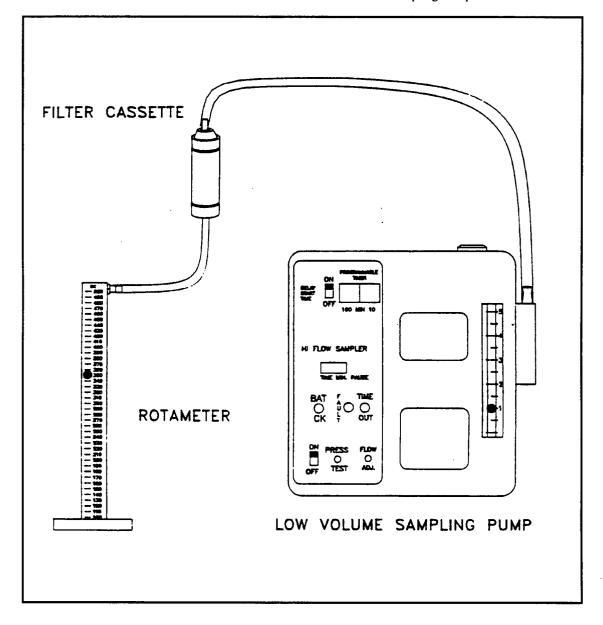
Element (Symbol)	Minimum Air Volume to be collected - Liters	Maximum Air Volume to be collected - Liters
Silver (Ag)	250	2000
Aluminum (Al)	5 ⁽¹⁾	100(1)
Arsenic (As)	5	2000
Beryllium (Be)	1250	2000
Calcium (Ca)	5	200
Cadmium (Cd)	13	2000
Cobalt (Co)	25	2000
Chromium (Cr)	5	1000
Copper (Cu)	5	1000
Iron (Fe)	5	100
Lithium (Li)	100	, 2000
Magnesium (Mg)	5	67
Manganese (Mn)	5	20
Molybdenum (Mo)	5	67
Sodium (Na)	13	2000
Nickel (Ni)	5	1000
Phosphorus (P)	25 ⁽¹⁾	2000(1)
Lead (Pb)	50	2000
Platinum (Pt)	1250	2000
Selenium (Se)	13	2000
Tin (Sn)	5	. 50
Tellurium (Te)	25	2000
Titanium (Ti)	5	100
Thallium (TI)	25	2000
Vanadium (V)	5	2000
Tungsten (W)	5(1)	200(1)
Yttrium (Y)	5	1000
Zinc (Zn)	5	200
Zirconium (Zr)	5	200

NOTE: Do not exceed a filter loading of approximately 2mg total dust.

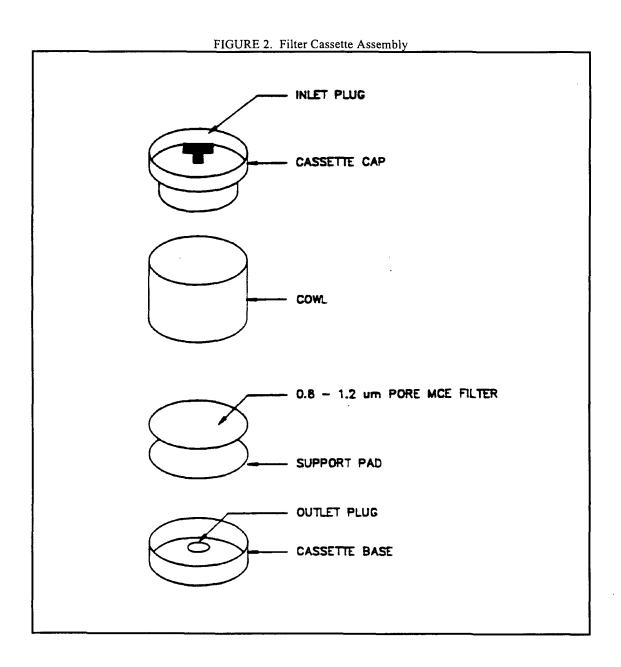
⁽¹⁾ Greater volumes may be required if the anticipated concentration is less than the ACGIH TLV.

APPENDIX B

FIGURE 1. Calibration Train with Low Volume Sampling Pump

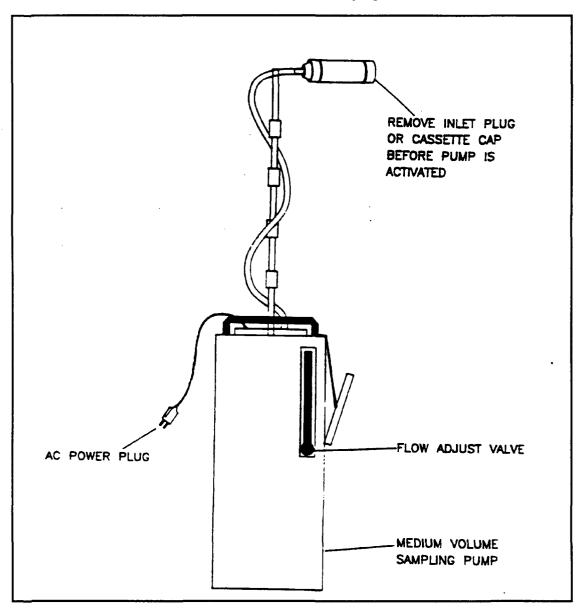


APPENDIX B (Cont'd)



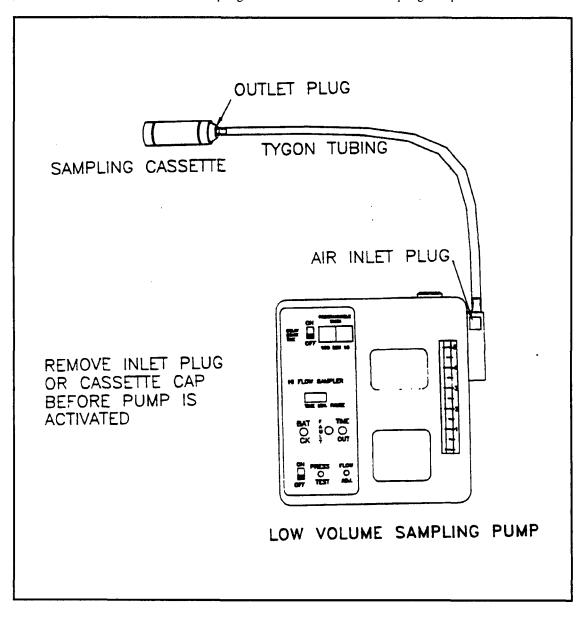
APPENDIX B (Cont'd)

FIGURE 3. Medium Volume Sampling Train



APPENDIX B (Cont'd)

FIGURE 4. Sampling Train with Low Volume Sampling Pump





HIGH VOLUME POLYURETHANE FOAM SAMPLING

SOP#: 2121 DATE: 08/07/95

REV. #: 0.1

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to outline the protocol for collection of air samples for organochlorine and organophosphate compounds (i.e., dioxins and polychlorinated biphenyls) using the polyurethane foam (PUF) sampling medium. The PUF sampling system is designed to simultaneously collect suspended airborne particulates and to trap airborne pesticide vapors.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, depending on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Ambient air is drawn into a covered housing then through a glass fiber filter and PUF plug by a high-flow-rate pump operating at approximately 250 liters/minute (L/m) (approximately nine cubic feet/minute [ft³/m]). This allows total suspended particulates (TSP) to collect on the filter surface. The PUF plug allows collection of vapor which might be stripped from the particulates on the filter.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Prior to sampling, determine whether pre- and postfilter weighing is appropriate based on project needs or client requirements. In addition, obtain pre-cleaned PUF plugs from the analytical laboratory. After sampling, the PUF plug and filter should be stored in an 8-oz. glass jar. The PUF plug should occupy the bottom portion of the jar and the filter should be folded into quarters and placed on top of the plug. The jar is then wrapped with aluminum foil (shiny side out).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Humidity - Glass fiber filters are comparatively insensitive to changes in relative humidity; however, collected particulate matter can be hygroscopic.

Photosensitivity - PUF plugs are white and turn yellow upon exposure to light. They should be stored in a dark place (i.e., a black trash bag or a cooler) prior to and after sampling.

5.0 EQUIPMENT/APPARATUS

5.1 Sampling Media (Sorbents)

Polyurethane Foam - polyether-type polyurethane foam (density No. 3014, 0.0225 grams/cm³, or equivalent). This is the type of foam generally used for furniture upholstery, pillows, and mattresses (General Metals Work's part number GPS-116 is recommended, three inch PUF plug, although one and two inch pieces are also available).

Glass Fiber Filter - 102-mm diameter.

5.2 Sampling Equipment

- PS-1 PUF Samplers or Equivalent (platform, legs, motor, magnehelic panel, tubing, venturi, and ball valves)
- Sample modules
- Calibration orifice
- Manometer
- Plastic bags
- Tweezers

- Aluminum foil
- Hexane
- Surgical gloves
- Solvex gloves
- Sample jars
- Trash bags
- Calibration Worksheets
- Air Sampling Worksheets (PUF)
- Logbook
- Computer or calculator to perform calculations
- Calibrated scale (if weighing is required)
- Source of electricity (AC/DC): an electrical source of 100 volts, 15 amps is required

6.0 REAGENTS

Reagents are not used for the preservation of PUF samples. Hexane is required for decontaminating PUF glassware. No other decontamination solutions are required.

7.0 PROCEDURES

7.1 Calibration of Elapsed-Time Meters and Calibration Orifices

Elapsed-Time Meter

Every six months the elapsed-time meter should be checked against a timepiece of known accuracy, either on site or in the laboratory. A gain or loss of >2 min/24-hr period warrants adjustment or replacement of the indicator. The results of these checks should be recorded in the calibration logbook.

Calibration Orifices

Upon receipt and at one-year intervals, calibration orifices should be certified with a positive displacement standard volume meter (such as a Rootsmeter) traceable to the National Bureau of Standards (NBS). This certification will be performed by the manufacturer. Calibration orifices should be visually inspected for signs of damage before each use, and they should be recalibrated if the inspection reveals any nicks or dents in the orifice.

7.2 General Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and

- the types and amounts of equipment and supplies needed.
- Obtain and organize the necessary sampling and monitoring equipment.
- 3. Decontaminate or pre-clean equipment and ensure that it is in working order.
- 4. Prepare scheduling and coordinate with staff, client, and regulatory agency, if appropriate.
- Perform a general site survey prior to site entry, in accordance with the site specific Health and Safety Plan.
- Use stakes or flagging tape to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

7.3 Sample Module Preparation

- 1. Pre-clean all sampling equipment with hexane prior to use.
- 2. Check the lower canister to ensure that the upper and lower orange silicone gaskets are in place (Figure 1, Appendix A).
- 3. Using tweezers, load the glass cartridge with a pre-cleaned PUF plug, making sure the foam is evenly distributed throughout the cartridge, and install in the lower canister.
- 4. Screw the filter holder support onto the lower canister, after ensuring that the silicone rubber gasket is in place.
- 5. Screw the filter holder with support screen onto the filter holder support, after ensuring that the silicone rubber gasket is in place.
- Install the lower Teflon gasket in the filter holder.
- Using tweezers to handle the filter, place glass fiber filter (rough side up) into the filter holder.
- 8. Install the upper Teflon gasket.

- 9. Ensure that the silicone rubber gasket is present and then install the filter retaining ring and tighten the swing bolts.
- 10. Ensure that all fittings are snug, yet not overtight (Overtightening will distort the gaskets.).
- 11. Cover the sample module with the metal cover and place in a cooler.
- 12. Assemble a field blank in the same manner and store in the same cooler.

It is recommended that two sampling modules are prepared for each sampling system so that the filter and PUF plug exchange may take place in the clean zone. The second set of modules is used for the subsequent sampling round.

7.4 Field Calibration of the Sampler

Calibration of the PUF sampler is performed without a PUF plug and without the glass fiber filter in the sampling module. However, the empty glass cartridge must remain in the module to ensure a good seal through the module.

Calibration of the PUF sampler is performed prior to using the sampling system in the field and after repair or replacement of major components of the sampling system (i.e., motor repair).

- 1. Assemble the sample module, as described in Section 7.2, without the PUF plug and without the glass fiber filter.
- Assemble the sampling system by attaching the legs and the magnehelic panel to the platform. Connect the motor to the platform, making sure that the gasket is placed between the motor and the platform.
- Plug the motor into the timer located on the magnehelic panel.
- 4. Connect the magnehelic to the venturi with tubing.
- 5. Place the sampling module into the quickrelease fitting and engage by locking the two levers down securely.

6. Connect the calibration orifice to the sample module (Figure 2, Appendix A). Ensure that

leaks exist between the orifice unit and the sampler.

- 7. Fill the manometer with colored water and connect it to the calibration orifice pressure tap with tubing.
- Set the manometer to "zero" as shown in Figure 3 (Appendix A). This is done by sliding the scale either up or down so the "zero" is level with the bottom of the meniscuses.
- 9. Connect the sampling system to the power source and fully open the ball valve by pushing the red lever up to the "on" position.
- 10. Fully open the voltage variator by using a screwdriver to turn the screw on the magnehelic gauge panel clockwise.
- 11. Operate the sampling system for at least 15 minutes to establish thermal equilibrium prior to calibration.
- 12. Conduct a five point calibration in the range of the desired flow rate as follows:
 - a. Adjust the voltage variator (located on the magnehelic gauge panel) and/or the ball valve to obtain a reading of 70 (arbitrary) inches on the magnehelic gauge.
 - b. The magnehelic gauge number, 70, is pre-recorded on the Field Calibration Work Sheet (Column #5, Attachment 1, Appendix B). Read and record (Column #4 on the Field Calibration Work Sheet) the total distance between the two meniscuses on the manometer (Figure 3, Appendix A). This is a measure of the pressure drop across the calibration orifice.
 - c. Move the ball valve (red lever) to adjust the magnehelic gauge down to 60 (arbitrary) inches. Let the sampler run for at least two minutes to re-establish the run temperature conditions. Repeat step 12 b.

- d. Using the above procedure (steps 12 b. and c.), adjust the ball valve for readings at 50, 40, and 30 inches.
- 13. Measure the barometric pressure and ambient temperature.
- 14. Record all data on the Field Calibration Work Sheet (Attachment 1, Appendix B). Perform calculations as described in Sections 8.1, 8.2, 8.3, and 8.4 of this SOP and record the appropriate results on the Field Calibration Work Sheet.
- 15. Adjust the ball valve to the magnehelic reading required to achieve the target volumetric flow rate as requested by the Work Assignment Manager.

7.5 Sampling

- 1. Verify that the sampler has been calibrated as described in Section 7.4.
- 2. Transport the sampler to the desired location. The PUF sampler must be operated in the breathing zone or it may be elevated. The sampler should be located in an unobstructed area, at a distance of twice the height of any obstruction to air flow, if possible, but no closer than two meters to the obstacle. In urban or congested areas, it is recommended that the sampler be placed on the roof of a single story building.
- 3. If it is not already set up, assemble the sampling system as described in Section 7.4 (Steps 2 to 4). Adjust the exhaust hose so that it faces downwind of the sampler.
- 4. Put on clean surgical gloves.
- 5. Place the loaded sampling module into the quick release fitting and engage by locking the two levers down securely. Refer to Figure 4 (Appendix A) for the complete setup of the sampling system.
- 6. Remove the metal cover.
- 7. Record the following information on the Air Sampling Worksheet (Attachment 2, Appendix B): high volume pump number,

- direction from site, location, sample start time, time/counter (start).
- 8. Plug in the unit.
- 9. If necessary adjust the magnehelic gauge to the reading required to achieve the target flow rate by turning the ball valve.
- Wait approximately two minutes for the magnehelic reading to stabilize.
- Allow the sampling system to operate for the duration determined by the Work Assignment Manager.
- 12. If the sampling system is to be in use for an extended period of time (i.e., the duration of sampling is greater than 24 hours), the initial calibration should be audited every 24 hours. This audit is accomplished by checking one point in the calibration curve using the field calibration procedure described in Section 7.4 and using a fully assembled sample module with the PUF plug and glass fiber filter installed. If the result of this check is greater than ±7% of the initial calibration value, the sampling system must be recalibrated.

7.6 Unit Shutdown and Sample Collection

- 1. Record the following information on the Air Sampling Worksheet (Attachment 2, Appendix B): sample stop time, time/counter (stop), the ending magnehelic reading, and whether or not there was a pump fault. Measure the ambient temperature and barometric pressure at the end of the sampling period. This information and the ending magnehelic gauge reading should be recorded on the Field Calibration Work Sheet.
- Unplug the sampler and remove the sample module.
- 3. Cover the sample module with the metal cover. Keep the sample module in a vertical position at all times.

- Place the sample module in a cooler for transport back to the command post. The field blank should also be stored in the same cooler.
- 5. If additional sampling is scheduled, perform a field calibration audit as described in Section 7.5, #12. The unit must be decontaminated with hexane and chem wipes prior to initiating additional sampling activities. Install a new sampling module and begin sampling as described in Section 7.5. If no additional sampling is scheduled, secure the unit.
- 6. Wearing surgical gloves and using tweezers, remove the PUF plug and place it in a clean 8-oz. glass jar. Fold the glass fiber filter into quarters and place it on top of the PUF plug. Label the jar appropriately and cover it with aluminum foil (shiny side out). Prepare the sample for transport to the laboratory for analysis, as necessary.
- 7. Calculate the post-sampling flow rate, the average flow rate, and the total volume sampled (Sections 8.5 and 8.6).

8.0 CALCULATIONS

The total volumes calculated for each sampling unit are corrected to standard conditions (760 millimeters of mercury [mm Hg] and 298 kelvin [K]). This is necessary for reporting the concentrations in a manner consistent with method requirements. The first step in the calibration process is to determine the slope (m) and the y-axis intercept (b) from the Factory Calibration Work Sheet. This is based on the formula y=mx+b. This is calculated either graphically (5-point calibration curve) or by a regression analysis of the data provided on the Factory Calibration Work Sheet. Once the slope and intercept are calculated for the factory calibration data, a calibration curve is developed for each of the sampling units. The important data elements needed to complete this task are the pressure drop readings for each of the arbitrary values (I) (Section 7.4), ambient temperature and ambient pressure. If the sampling unit calibration results will be provided in mm Hg instead of inches of water, then Section 8.1 may be skipped because the manufacturer has already calculated the slope (m) and intercept (b) and provided them on the Factory Calibration Work Sheet. This information

should be recorded in the appropriate location on the Field Calibration Work Sheet.

8.1 Determining the Slope (m) and Y-Axis Intercept (b) of the Factory Calibration

- Obtain the current Factory Calibration Work
 Sheet from manufacture's calibration kit or
 Air Team Calibration File. See Figure 5
 (Appendix A) for an example.
- 2. Copy columns #6 & #7 from the Q_{std} section of the Factory Calibration Work Sheet to column #1 & #2, respectively, on the Field Calibration Work Sheet (Attachment 1, Appendix B). Record the ambient temperature, ambient pressure at which the factory orifice calibration was performed, and orifice serial number from the Factory Calibration Work Sheet in the respective locations on the Field Calibration Work Sheet. Return the Factory Calibration Work Sheet to the calibration kit or the proper file.
- 3. Solve the following formula for every calibration orifice static pressure found in column #1 of the Field Calibration Work Sheet. Record results in column #3 of the Field Calibration Work Sheet. The units of the results are arbitrary. There should be at least five computations.

Equation:

y-axis equation orifice = $[\Delta H(P_a/760)(298/T_a)]^{1/2}$

Where:

- $\Delta H =$ Calibration orifice static pressure in inches of water (" H_2O) (Field Calibration Work Sheet, column #1).
- P_a = Ambient pressure at which the factory orifice calibration was performed in mm Hg.
- T_a = Ambient temperature at which the factory orifice calibration was performed in K.

Example:

 $\Delta H = 2.0 \text{ "}H_2O, P_a = 760.5 \text{mm Hg}, T_a = 295 \text{ K}$

y-axis equation orifice = [(2.0 $^{\circ}$ H₂O)(760.5mm Hg/760 mm Hg)(298 K/295 K)]^{1/2}

y-axis equation orifice = $[2.02]^{1/2}$

y-axis equation orifice = 1.42

4. Graph the results in column #2 of the Field Calibration Work Sheet on the x-axis against the data presented in column #3 of the Field Calibration Work Sheet on the y-axis or perform a regression analysis of the data to determine the slope and (m) and the y-axis intercept (b). Record in the appropriate location on the Field Calibration Work Sheet.

Example: Regression analysis from Lotus 123:

Regression Output:

Constant	- 0.03
Std Err of Y Est	0.00246358
R Squared	0.99999508
No. of Observations	6
Degrees of Freedom	4

X Coefficient(s) 9.52 Std Err of Coef. 0.01055231

Where:

Constant = y-Axis intercept (b) X Coefficient(s) = Slope (m)

8.2 Determining the Slope (m) and a Y-Axis Intercept (b) of the Field Calibration

1. Obtain pressure drop readings from the water manometer and the matching arbitrary magnehelic values (I = 70, 60, 50, 40, 30) from Section 7.4 and record the data on a Field Calibration Work Sheet in columns #4 and #5, respectively. Record the ambient temperature and ambient pressure at which each unit calibration was performed.

 Solve the y-axis equation using the formula below and using the data found in column #4 on the Field Calibration Work Sheet. Record the results in column #6 of the Field Calibration Work Sheet. The units of the results are arbitrary. There should be at least five computations.

Equation:

y-axis equation sampling unit = $[\Delta H(P_a/760)(298/T_a)]^{1/2}$

Where:

 $\Delta H =$ Static pressure of the sampling unit in "H₂O (column #4 of the Field Calibration Work Sheet).

P_a = Ambient pressure in mm Hg at time of unit calibration.

T_a = Ambient temperature in K at time of unit calibration.

Example:

 $_{\Delta}H = 6.0 \text{ "}H_{2}O, P_{a} = 756.92 \text{mm Hg}, T_{a} = 295 \text{ K}$

y-axis equation sampling unit = $[(6.0 \text{ "H}_2\text{O})(756.92 \text{ mm Hg}/760 \text{ mm Hg})(298 \text{ K}/295 \text{ K})]^{1/2}$

y-axis equation sampling unit = $[6.06]^{1/2}$

y-axis equation sampling unit = 2.46

3. Determine the volumetric flow rate (Q_{STD}) for each calibration point using the following equation. Record the results in column #7 of the Field Calibration Work Sheet.

Equation:

OSTD = $1/m \left[\left\{ \Delta H(P_a/760)(298/T_a) \right\}^{1/2} - b \right]$

Where:

m = Slope from the Factory Calibration Work Sheet graph or regression analysis (Step #4, Section 8.1).

 $\Delta H =$ Pressure drop in " H_2O recorded on Field Calibration Work Sheet (column #4).

- P_a = Ambient pressure in mm Hg at time of field calibration.
- T_a = Ambient temperature in K at time of field calibration.
- b = y-Axis intercept from the Factory Calibration Work Sheet graph or regression analysis (Step #4, Section 8.1).

Example:

m = 9.52, Δ H = 6.0 "H₂O, P_a = 756.92 mm Hg, T_a = 295 K, b = -0.03

 $Q_{STD} = 1/9.52 [\{6.0 \text{ "H}_2\text{O} (756.92 \text{ mm} \text{Hg}/760 \text{ mm Hg})(298 \text{ K}/295 \text{ K})\}^{1/2} - (-0.03)]$

 $Q_{STD} = 1/9.52 [2.46]$

 $Q_{STD} = 0.26 \text{ m}^3/\text{min}$

 Determine the Y_{value} for each calibration point. Record in column #8 on the Field Calibration Work Sheet. The units of the results are arbitrary.

Equation:

 Y_{value} of each calibration point = $[I(P_a/760)(298/T_a)]^{1/2}$

Where:

- I = Arbitrary value located in column #5 on the Field Calibration Work Sheet
- P_a = Ambient pressure in mm Hg at time of unit field calibration.
- T_a = Ambient temperature in K at time of unit field calibration.

Example:

I = 70, $P_a = 756.92$ mm Hg, $T_a = 295$ K

 Y_{value} of each calibration point = $[70(756.92 \text{mm Hg}/760 \text{ mm Hg})(298 \text{ K}/295 \text{ K})]^{1/2}$

 Y_{value} of each calibration point = 8.39

5. Graph the results in column #7 of the Field Calibration Work Sheet on the x-axis against

the data presented in column #8 from the Field Calibration Work Sheet on the y-axis or perform a regression analysis to determine the slope (m) and the y-axis intercept (b). Record in the appropriate location on the Field Calibration Work Sheet.

Example: Regression analysis from Lotus 123:

Regression Output:

Constant	1.64
Std Err of Y Est	0.057770455
R Squared	0.998738313
No. of Observations	6
Degrees of Freedom	4

X Coefficient(s) 25.66 Std Err of Coef. 0.45593301

Where:

Constant = y-axis intercept (b) X Coefficient(s) = Slope (m)

8.3 Checking the Linearity of the Calibration

1. Calculate Y_{cal} to determine if the calibration is within the limits of linearity (±5%) using the following formulas. Record the results in column #9 of the Field Calibration Work Sheet.

Equation: $Y_{cal} = mQ_{STD} + b$

Where:

- m = Slope of the field calibration curve from the regression analysis of columns #7 & #8.
- Q_{STD} = Volumetric flow rate calculated on the Field Calibration Work Sheet (column #7).
- b = y-Axis intercept of the field calibration curve from the regression analysis of columns #7 and #8.

Example:

m = 25.66, $Q_{STD} = 0.26$, b = 1.64

$$Y_{cal} = [(25.66)(0.26)] + 1.64$$

$$Y_{cal} = 8.31$$

2. Calculate %-difference of the Y_{value} and Y_{cal} . Record the results in column #10 of the Field Calibration Work Sheet. If the results are not with in $\pm 5\%$ recheck your calculations or recalibrate.

Equation:

%-difference =
$$((Y_{value} - Y_{cal})/Y_{cal})(100)$$

Where:

Y_{value} = Y_{value} in column #8 of the Field Calibration Work Sheet.

Y_{cal} = Value from previous calculation recorded in column #9 of the Field Calibration Work Sheet.

Example:

%-difference = ((8.39 - 8.31)/8.31)100

%-difference = 0.96%

8.4 Determining Pre-Sampling Volumetric Flow Rate

1. Determine the volumetric flow rate at each calibration point using the following equation and recording the data in column #11 of the Field Calibration Work Sheet.

Equation:

$$Q = (1/m)[\{I(P_a/760)(298/T_a)\}^{1/2} -b]$$

Where:

- I = Arbitrary magnehelic reading recorded on Field Calibration Work Sheet (column #5).
- P_a = Ambient pressure in mm Hg at which the sampling unit was calibrated.
- T_a = Ambient temperature in K at which the sampling unit was calibrated.
- b = y-Axis intercept from the field calibration graph or regression analysis of columns #7 & #8.

m = Slope from the field calibration curve graph or regression analysis of columns #7 & #8.

Example:

I = 70, $P_a = 756.92$ mm Hg, $T_a = 295$ K, m = 25.66, b = 1.64

Q = $(1/25.66)[\{70(756.92mm Hg/760mmHg)(298 K/295 K)\}^{1/2} -1.64]$

 $O = 0.26 \text{ m}^3/\text{min}$

- Determine the arbitrary set point for a target volumetric flow rate, as follows.
 - a. Obtain the target volumetric flow rate in m³/min from the Work Assignment Manager.
 - b. Obtain the ambient barometric pressure and the ambient temperature at the start of the sampling event and record on the Field Calibration Work Sheet.
 - c. Using the following equation calculate your arbitrary set point for each sampler. Record in the appropriate location on the Field Calibration Work Sheet.

Equation:

$$I = [\{(Q_{target})(m)\} + b]^{2}/[(P_{a}/760)(298/T_{a})]$$

Where:

 $Q_{target} = Desired$ volumetric flow rate $(m^3/min.)$

m = Slope of the field calibration as determined by the regression of columns #7 & #8.

b = y-Axis intercept of the field calibration as determined by the regression of columns #7 & #8.

P_a = Ambient pressure at which the sample is being taken (mm Hg)

 T_a = Ambient temperature at which the sample is being taken (K)

Example:

What is the magnehelic set point (I) for the target flow rate of 0.25 m³/min.?

$$m = 25.66$$
, $b = 1.64$, $P_a = 756.92$ mm Hg, $T_a = 295$ K

- $I = [(0.25m^3/min.)(25.66)+1.64]^2/[(756.92/760)(298/295)]$
- I = 64.49

- 3. Determine the initial flow rate, as follows.
 - a. Set the magnehelic set point (I) as determined by the previous step.
 - Use the following equation to check the set point to determine if is the correct set point for the desired flow rate.

Equation:

 $Q = (1/m)[\{I(P_a/760)(298/T_a)\}^{1/2} -b]$

Where:

Q = Volumetric flow rate at set point (I).

I = Magnehelic set point (I).

P_a = Ambient pressure at the start of the sampling event.

T_a = Ambient temperature in K at the start of the sampling event.

b = y-Axis intercept from the field calibration graph or regression analysis of column #7 & #8.

m = Slope from the field calibration curve graph or regression analysis of column #7 & #8.

Example:

I = 64.49, $P_a = 756.9$ mm Hg, $T_a = 295$ K, m = 25.66, b = 1.64

Q = $1/25.66[\{64.49(756.9 \text{mmHg}/760 \text{mmHg})\}]^{1/2} - 1.64]$

 $Q = 0.25 \text{ m}^3/\text{min.}$

8.5 Determining Post-Sampling Volumetric Flow Rate

- Obtain the ambient barometric pressure and the ambient temperature at the end of the sampling event and record on the Field Calibration Work Sheet.
- 2. Obtain the set point (I) of the magnehelic at the end of the sampling event and record on the Field Calibration Work Sheet.
- 3. Use the following equation to determine the

volumetric flow rate.

Equation:

 $Q = (1/m)[\{I(P_a/760)(298/T_a)\}^{1/2} - b]$

Where:

Q = Volumetric flow rate at set point (I).

I = Magnehelic set point (I) at the end of the sampling event.

P_a = Ambient pressure at the end of the sampling event.

T_a = Ambient temperature in K at the end of the sampling event.

b = y-Axis intercept from the field calibration graph or regression analysis of columns #7 & #8.

m = Slope from the field calibration curve graph or regression analysis of columns #7 & #8.

Example:

I = 50, $P_a = 758.9$ mm Hg, $T_a = 299$ K, m = 25.66, b = 1.64

Q = 1/25.66)[$\{50(758.9 \text{mmHg}/760 \text{mm Hg})$ (298 K/299 K) $\}^{1/2}$ -1.64]

 $Q = 0.21 \text{ m}^3/\text{min}.$

8.6 Determining Total Volume

Average the pre- and post-volumetric flow rates and multiply by the time sampled to determine the volume sampled. Record all information on the Field Calibration Work Sheet.

Example:

 $((0.25 \text{m}^3/\text{min} + 0.21 \text{m}^3/\text{min})/2)480 \text{ min} = 110.4 \text{ m}^3$

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

Provide one field blank per sampling period or one field blank for every 20 samples, whichever is greater. A field blank is treated exactly as a sample except that air is not drawn through the media. PUF plugs should be submitted to the laboratory for cleaning prior to field sampling. If the PUF plugs were cleaned in

house, one or two clean plugs should be sent to the laboratory which will be analyzing the samples. Sample spiking may be necessary for pesticide and PCB samples; consult with the Work Assignment Manager.

10.0 DATA VALIDATION

Results of the quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results in accordance with the data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials follow U.S. EPA, OSHA, and corporate health and safety practices.

12.0 REFERENCES

Method TO4, Determination of Organochlorine Pesticides and Polychlorinated Biphenyls in Ambient Air, Revision 1.0, April, 1984.

APPENDIX A

FIGURE 1. Sample Module

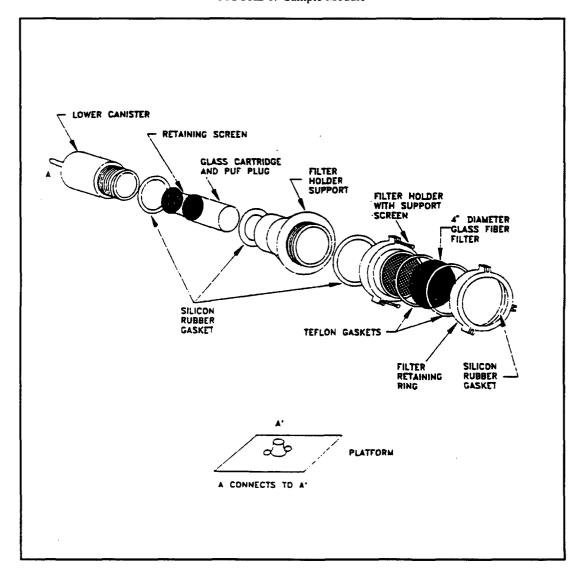


FIGURE 2. Calibration of the PUF Sampler

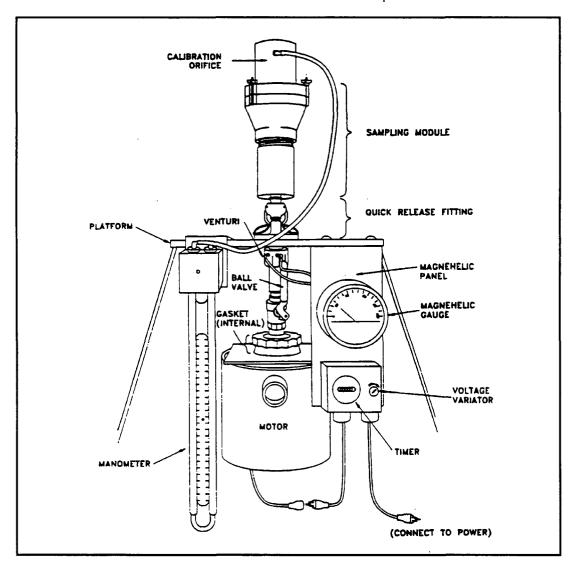


FIGURE 3. Manometer

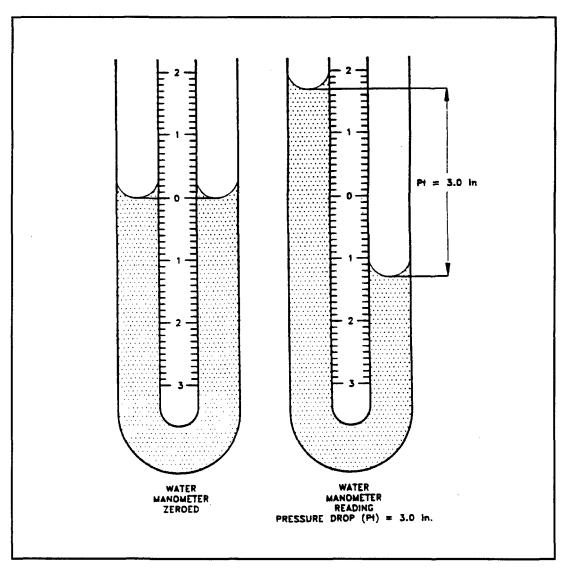
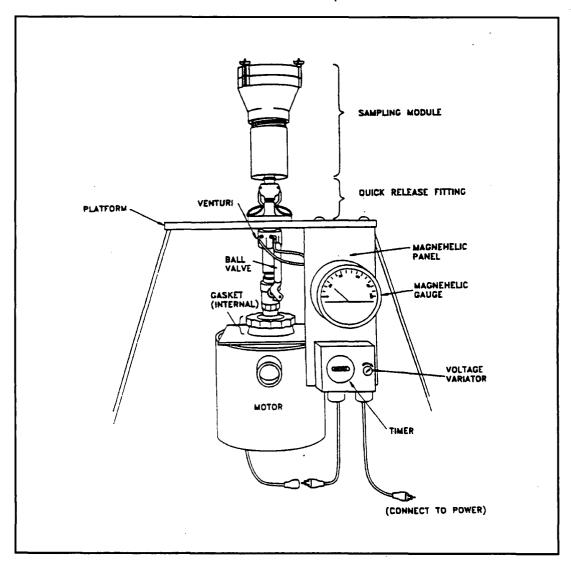


FIGURE 4. PUF Sampler



Figures

FIGURE 5. Factory Calibration Work Sheet

GRASEBY/ GMW 145 South M1am1 Avenu Cleves, OH 45002 Tel. (513) 941-2229

High Volume Orifice Calibration Certificate

Ta: 2 RH: 9	22.0 °C 57 %				odel No.: 40/ ertal No.: 7			alibration Da ate placed in	
				Q St	andard Ca	libratio	n Data		
(1) Run Point No.	(2) Elapsed Time-Δt Min.	(3) Initial Volume VM M3	(4) Meter Inlet Static Pressure-AP mm of Hg	(5) Standard Volume Vstd M3	Calii Ori	tic	(7) X Metric Flow Rate Qstd M3/min.	(8) English Flow Rate Qstd ft3/min.	(9) Y
1 2 3 4 5	6.434 3.898 3.126 2.661 2.355 2.203	1 1 1 1 1 1 1 1	3.3 9.7 15.1 20.6 26.0 29.6	0.991 0.982 0.975 0.968 0.961 0.956	2.0 5.5 8.5 11.5 14.5 16.5	3.74 10.27 15.87 21.48 27.08 30.82	0.154 0.252 0.312 0.364 0.408 0.434	5.4 8.9 11.0 12.8 14.4 15.3	1.411 2.340 2.909 3.383 3.799 4.052
	Slop	e(m); 9.41	Interd	ept(b):	-0.035310	Correla	tion Coeffic	lent(r): 0.	999985
				Q A	Actual Ca	libration	Data		
Run Point No.	(2) Elapsed Time-Δt Min.	(3) Initial Volume VM _M 3	(4) Meter Inlet Static Pressure-ΔP mm of Hg	(5a) Actual Volume Va M3	Calii Ori: Sta	5) prator fice stic sure-∆H mm of Hg	(7a) X Metric Flow Rate Qa M ³ /min.		(9a) Y AH (Ta)
1 2 3 4 5	6.434 3.898 3.126 2.661 2.355 2.203	1 1 1 1 1	3.3 9.7 15.1 20.6 26.0 29.6	0.996 0.987 0.980 0.973 0.966 0.961	2.0 5.5 8.5 11.5 14.5 16.5	3.74 10.27 15.87 21.48 27.08 30.82	0.155 0.253 0.314 0.366 0.410 0.436		0.888 1.472 1.831 2.129 2.391 2.550
	Slop	e(m): 5.89	Interd	cept(b):	-0.021285	Correla	tion Coeffic	lent(r): 0.	999985
quati	ons:				<u> </u>		Standar	d Condit	ions:
V	std(5) - Vm	$\frac{(Pa-\Delta P)}{Pstd}$		Qstd	- Vstd - At		T: P:	std= 25°C= 2 std= 760mm a	98.18°K f Hg
v	a(5a) - Vm(3) (Pa-ΔP) Pstd	Q	- Vstd Δt					

For additional information consult:

- The Federal Register. Vol.47, No. 234. pp. 54896-54921. December 6. 1982.
 Quality Assurance Handbook, Vol.11 (EPA 600/4-77-277a). Section 2.11.
 Graseby/GPM/Andersen Instruction Manual.

Notes:

1. EPA recommends calibrators should be recalibrated after one year of field use.

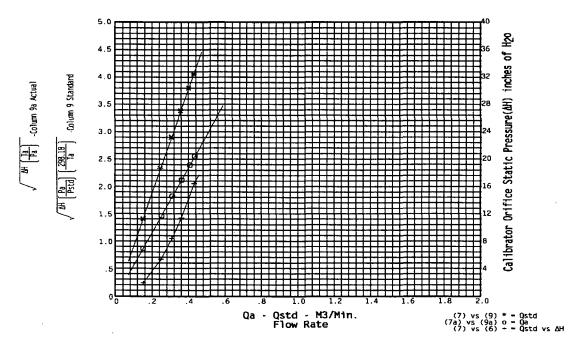
@1993 BGI IR. RW. 1.3

Certificate for 77c page 1 of 2

Figures

FIGURE 5. Factory Calibration Work Sheet (Cont'd)

Plot of Linear Regression Qstd/Qa and Traditional Qstd - ΔP (Note ΔH is inches of H2o)



Use of <u>Curve</u> for determining Qa or Qstd.

To find Qa calculate:

To find Qstd calculate:

Ostd-
$$\left(\Delta H - \frac{Pa}{760} - \frac{298.18}{Ta}\right)^{\frac{1}{2}}$$

©1993 BGI ING Rev. 1.3

To find Qa or Qstd by Calculation.

To determine Qa calculate:

Qstd-
$$\left(\frac{\Delta H - \frac{Pa}{760} - \frac{298.18}{1a} \right)^{\frac{1}{4}} - b}{m}$$

Certificate for 770 page 2 of 2

APPENDIX B

Attachments

ATTACHMENT 1. Field Calibration Work Sheet



ENVIRONMENTAL RESPONSE TEAM HIGH VOLUME SAMPLER FIELD CALIBRATION WORK SHEET

_		
Page	01	

i	- · · · · · · · · · · · · · · · · · · ·		_	WA#:				Date:		
plers:				EPA/ER	T WAM:			REAC TL:Location/Station:		
pler #:										
					IFICE CALIBRAT ed from the Factor					
ient Pressur	e (mmHg):			Amb	ient Temperature	(kelvin):			Serial #:	
					Unit Calibrati	on Information				•
oient Pressur	e (mmHg):							Ambient Ter	nporaturo (kelvin): _	
	alibration Data				Calibration Cur	/e		Linearity of C	Calibration Curve	
#1	n	#3	#4	#5	#6	#7	#8	#9	#10	#11
Calibrator Orifice Static Pressure (AH)	Metric Flow Rate Q _{ad} (m ³ /min) (x-axis)	y-axis Equation Orifice	Δ H Sampling Unit ("H ₂ O)	Pressure Indicator of the Sampling Unit (I) (arbitrary)	y-axis Equation of the Sampling Unit	Q _{ad} Orifice Calibration (x-axis)	y-value of Each Calibration Point (y-axis)	y-caļ	% Difference (+/- 5%)	Flow Rate for Each Calibration Point

Attachments

ATTACHMENT 2. Air Sampling Worksheet



ENVIRONMENTAL RESPONSE TEAM HIGH VOLUME AIR SAMPLING WORK SHEET

Page	of	

Site:			WA		
Samplers:			EPA/ERT WAN	A:	·····
Date:			REAC Task Leads	r:	
		— —			
Sample #					
Location			· · · · · · · · · · · · · · · · · · ·		
Sampler ID					
Media					
Analysis/Method					
Time/Counter (Start)					
Time/Counter (Stop)					
Total Time					
Ambient Temperature (kelvin) Start					
Ambient Barometric Pressure (mmHg) Start				· .	
Ambient Temperature (kelvin) Stop					
Ambient Barometric Pressure (mmHg) Stop					
Magnehelic Reading (Pre)					
Magnehelic Reading (Post)					
Flow Rate (Pre)					
Flow Rate (Post)					
Flow Rate (Average)					
Volume					
MET Station On-site? Y	/ N				
General Comments:		ч			

PART B:

SITE MANAGEMENT PLAN

USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
SITE MANAGEMENT PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

NOTICE

THE INFORMATION PROVIDED IN THIS DOCUMENT HAS BEEN FUNDED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) UNDER RAC II CONTRACT NO. 68-W-98-214 TO FOSTER WHEELER ENVIRONMENTAL CORPORATION (FOSTER WHEELER ENVIRONMENTAL). THIS DOCUMENT HAS BEEN FORMALLY RELEASED BY FOSTER WHEELER ENVIRONMENTAL TO THE USEPA. THIS DOCUMENT DOES NOT, HOWEVER, REPRESENT USEPA POSITION OR POLICY, AND HAS NOT BEEN FORMALLY RELEASED BY THE USEPA.

USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
SITE MANAGEMENT PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

Prepared by:

Lynn Niles

Environmental Chemist

Foster Wheeler Environmental

Reviewed by:

Ming Kuo, PhD, PE

RAC II Technical Quality Control Manager

Foster Wheeler Environmental

Approved by:

Der R. Sachelin

Dev R. Sachdev, PhD, PE

RAC II Program Manager

Foster Wheeler Environmental

TABLE OF CONTENTS

Sect	on Page
1.0	<u>INTRODUCTION</u> 1
2.0	SITE DESCRIPTION
	2.1 GENERAL12.2 SITE ACCESS/CONTROL12.3 FIELD OFFICE/COMMAND POST42.4 TRAFFIC CONTROL/PARKING42.5 MAJOR EQUIPMENT MOBILIZATION AND STORAGE4
3.0	SITE OPERATIONS 4
	3.1 CONCEPT OF THE OPERATION43.2 PROJECT ORGANIZATION53.3 RESPONSIBILITIES53.4 PROPERTY ACCOUNTABILITY7
4.0	FIELD OPERATIONS SCHEDULE
	LIST OF FIGURES
<u>No.</u>	<u>Title</u> Page
1	Site Location Map
2	Site Plan Map
3	Project Organization Structure

1.0 INTRODUCTION

This Site Management Plan (SMP) has been developed to support the field investigation to be conducted at the Cornell-Dubilier Electronics Superfund (Cornell-Dubilier) Site in South Plainfield, Middlesex County, New Jersey. The SMP includes a Site description, an operations plan, which includes project organization and responsibilities.

2.0 SITE DESCRIPTION

2.1 GENERAL

The Cornell-Dubilier Site is a 25-acre site located at 333 Hamilton Boulevard, in South Plainfield, Middlesex County, New Jersey. The Hamilton Industrial Park, which consists of approximately 15 small industries, currently occupies the Site property. The Site is bordered by Bound Brook and railway tracks to the northeast, Hamilton Boulevard and residential and commercial properties to the northwest, the South Plainfield Department of Public Works propety to the southeast, and Spicer Avenue and residential properties to the southwest.

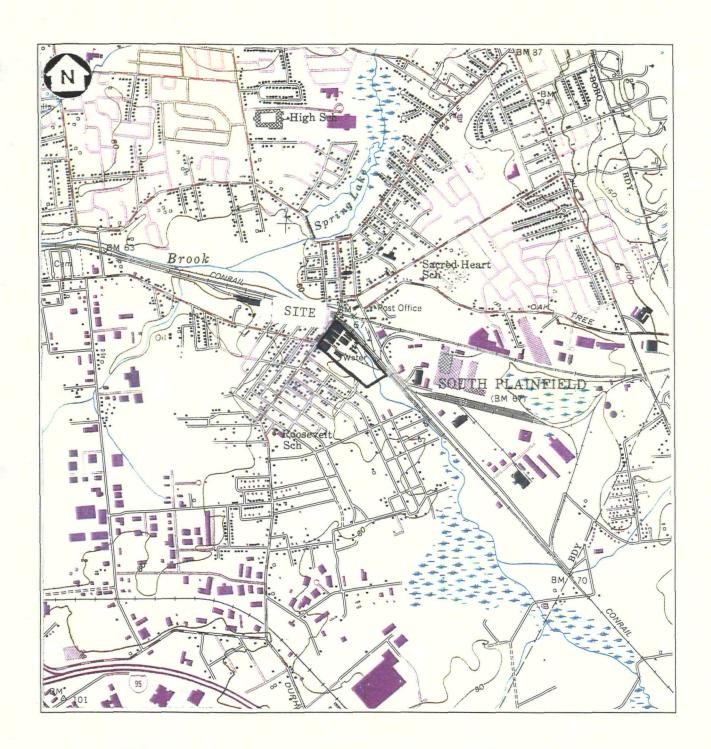
From 1936 to 1962, Cornell-Dubilier Electronics, Inc. manufactured electronic components, including capacitors, on the Site property. Allegedly, during its operations, the company disposed of transformer oil and other materials contaminated with polychlorinated biphenyls (PCBs) directly onto Site soils. Residual wastes from the on-site processes may also have been landfilled on the Site property, including trichloroethene (TCE), which was used during operations as a degreasing agent.

Figure 1 is a Site Location Map showing the general Site location, and Figure 2 is a Site Plan Map showing the major site features and equipment staging area for the field investigation.

2.2 SITE ACCESS/CONTROL

The United States Environmental Protection Agency (USEPA) will be responsible for obtaining any access approvals needed for Foster Wheeler Environmental and its subcontractors to perform field activities throughout the Site and in the nearby residential community.

At the present time, access to the property is restricted to the northeast, northwest and southwest by a fence, with gates in the western corner of the Site along Hamilton Boulevard and near the southern corner of the Site along Spicer Avenue (across from Fulton Street). The Hamilton Boulevard gate will be the main access point for personnel performing field activities at the Site, with secondary access through the Spicer Avenue gate only when necessary for Site activities. The southeastern portion of the property has no formal access restrictions; however, the low-lying floodplain area along Bound Brook and the steep grade (approximately 12 feet) serve as natural barriers to prevent access (see Figure 2). No additional access restrictions are presently scheduled at this time.



SOURCE: US Geological Survey 7.5-minute topographic map for Plainfield, New Jersey.

SCALE: 1: 24 000

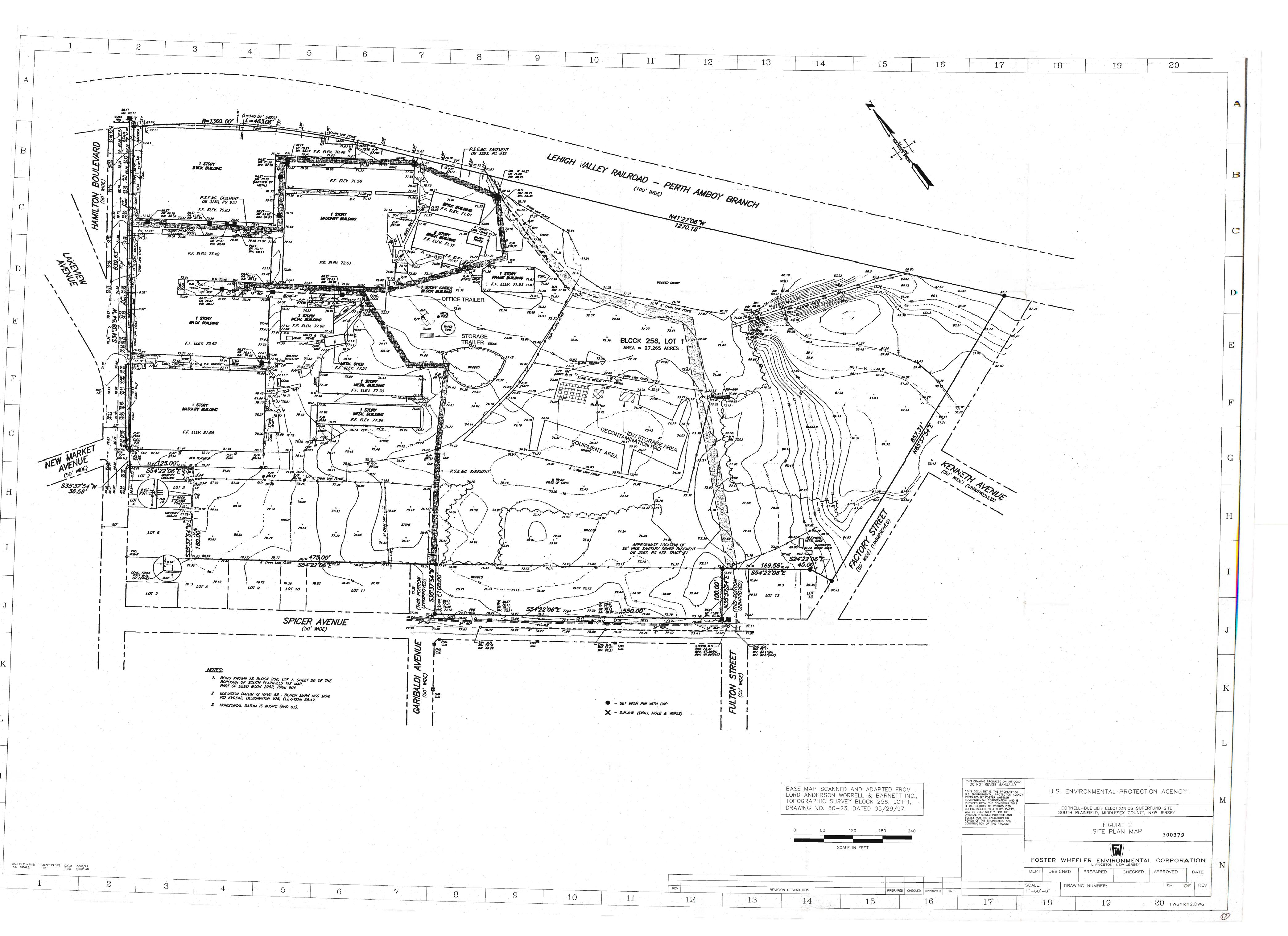
US ENVIRONMENTAL PROTECTION AGENCY

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, MIDDLESEX COUNTY, NEW JERSEY

FIGURE 1 SITE LOCATION MAP

FOSTER WHEELER ENVIRONMENTAL CORPORATION



THIS PAGE WAS INTENTIONALLY LEFT BLANK FOR PAGINATION PURPOSES

2.3 FIELD OFFICE/COMMAND POST

Foster Wheeler Environmental will maintain an office trailer and a storage trailer on the Site for at least the duration of each phase of the field investigation. Depending on time lag and rental costs, the trailers may be demobilized between investigation phases. Utilities (to include telephone) will be installed. The trailer will be locked at the end of each work day. The approximate location of the trailers is shown on Figure 2.

2.4 TRAFFIC CONTROL/PARKING

Parking for official vehicles will be on the paved portion of the Site near the office trailer, without blocking access to any of the buildings (see Figure 2). Drill rigs and other essential equipment will be the only vehicles permitted onto non-parking areas of the Site.

2.5 MAJOR EQUIPMENT MOBILIZATION AND STORAGE

Additional equipment that will be mobilized to the Site to support the field investigation includes drums and/or a frac tank for temporary storage of investigation-derived wastes (IDW) generated during the field program, drilling equipment for monitoring well installation/subsurface soil sample collection, excavation equipment for test pit investigation, and a 14-foot aluminum john boat for sediment/surface water/biota sample collection (if necessary during the Phase II Investigation). The drums and/or frac tank will be placed on the blacktop-covered area in the central portion of the Site, which is fenced (drums will be on pallets), and will remain on-site throughout the field investigation until proper disposal. Drilling and excavation equipment will be mobilized to the Site as needed for completion of field activities. This equipment will be staged throughout the Site while in use, but will be parked on the blacktop-covered area in the central portion of the Site during periods of inactivity. The decontamination pad will also be constructed in this blacktop-covered area. Figure 2 shows the staging locations for the field equipment.

3.0 <u>SITE OPERATIONS</u>

3.1 CONCEPT OF THE OPERATION

The concept of the operation for the field investigation provides for the on-site presence of the Field Operations Leader (FOL) and Environmental and Safety Supervisor (ESS) during all critical operations, including:

- Geophysical Survey
- Soil Gas Survey
- Dye Testing
- Test Pit and Habitat Delineation
- Wetlands and Habitat Delineation
- Surface Soil Sampling

- Subsurface Soil Sampling
- Hydropunch Sampling
- Monitoring Well Installation/Development
- Drainage System Sampling
- Building Interior Sampling [Floor Dust]
- Building Interior Sampling [Air] (Phase II)
- Sediment Sampling (potential Phase II)
- Surface Water Sampling (potential Phase II)
- Biota Sampling (potential Phase II)
- Groundwater Sampling and Measurement
- Aquifer Testing (Phase II)

3.2 PROJECT ORGANIZATION

The proposed project organization for the field investigation effort is shown in Figure 3.

3.3 RESPONSIBILITIES

The Program Manager, Dr. Dev Sachdev, is responsible for the quality of all RAC II work performed by Foster Wheeler Environmental, including subcontractor performance. He monitors the progress of each work assignment to ensure that adequate resources are available and that major quality problems are prevented or minimized. The Program Manager implements the program standard of quality for work under the contract and ensures that the Project Manager adheres to that standard. The Program Manager's review concentrates on the technical quality, schedule, and cost for all work assignments.

The Project Manager (PM), Dr. Daniel Miller, has primary responsibility and authority for implementing and executing the field investigation. The Project Manager is accountable for ensuring that the field investigation is conducted in accordance with RAC II procedures/guidelines and ultimately achieves the goals established in the Work Plan and Field Operations Plan (FOP). He is also responsible for monitoring the budget to control costs, ensuring adequate staffing for the field investigation, and resolving problems within his authority.

The Field Operations Leader (FOL), Ms. Lynn Niles, is the principal Foster Wheeler Environmental agent on Site. The FOL will be assigned to the project prior to Site mobilization. She reports directly to the PM during the field investigation and has direct supervision of personnel assigned to the Site. The FOL is responsible for the implementation of the FOP and for on-site management for the duration of all activity at the Site. She is also responsible for ensuring that all appropriate RAC II procedures/guidelines are followed, control of subcontractors entering the Site, execution of the sampling program in accordance with the approved plans and appropriate protocols, control of field expenses within his authorization, maintenance of the field office and storage trailer, proper storage and disposal of wastes, and accountability of Foster Wheeler Environmental controlled property.

The FOL will be supported by the Site Geologist, Site Chemist, Site Ecologist, and other technical personnel, as necessary to support the work being conducted.

The Site-specific quality assurance requirements will be in accordance with the Quality Assurance Project Plans for the RAC II Program and the Site-specific Quality Assurance Project Plan (QAPP; Part C of the FOP). Health and Safety requirements will be in accordance with the Environmental Health and Safety Plan for the RAC II Program and the Site-specific Environmental Health and Safety Plan (EHS Plan; Part D of the FOP), as supported by the Program Environmental and Safety Manager, Mr. Joseph Sbarra.

A Site-specific QA Officer will be assigned to the Cornell-Dubilier project, to hold responsibility for on-site QA activities, including performance of audits and verification of corrective actions. In addition, the QA Officer will coordinate with the PM, the Site Chemist and other project staff, as applicable, during the reduction, review and reporting of the analytical data.

The Site-specific Environmental and Safety Supervisor (ESS), Mr. John Lane, is responsible for the implementation of the Site-specific EHS Plan. Ms. Tiffany Sollog is designated as the alternate ESS, in the event that Mr. Lane cannot serve in that capacity. The ESS shall advise the project staff on health and safety issues, conduct health and safety training sessions, and monitor the effectiveness of the health and safety program conducted in the field. The ESS, acting for the safety of all Site personnel, has the authority to stop work during the field activities.

3.4 PROPERTY ACCOUNTABILITY

The FOL is responsible for accountability of Foster Wheeler Environmental-owned and controlled property on the Site. He/she will ensure that equipment is properly secured, maintained, operated, decontaminated, cleaned and utilized. The FOL will maintain an inventory of consumable and disposable supplies on-site and control access to them, and will ensure that supplies are stored properly and used only for their intended purpose.

4.0 FIELD OPERATIONS SCHEDULE

Activities associated with the field investigation are designed to obtain geologic, hydrogeologic, chemical and ecological data in support of the Human Health and Ecological Risk Assessments and the Feasibility Study. The project schedule is presented as Figure 4-2 of the Work Plan.

The field investigation will be separated into three phases. The estimated duration for each of the phases, as indicated in Figure 4-2 of the Work Plan, shall be as follows:

Activity Phase	Start Date	End Date	Estimated Duration (days)
Reconnaissance Phase	May 1, 2000	Aug 2, 2000	66
Phase I Investigation	Aug 3, 2000	Oct 13, 2000	47

PART C: QUALITY ASSURANCE PROJECT PLAN

USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
QUALITY ASSURANCE PROJECT PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

NOTICE

THE INFORMATION PROVIDED IN THIS DOCUMENT HAS BEEN FUNDED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) UNDER RAC II CONTRACT NO. 68-W-98-214 TO FOSTER WHEELER ENVIRONMENTAL CORPORATION (FOSTER WHEELER ENVIRONMENTAL). THIS DOCUMENT HAS BEEN FORMALLY RELEASED BY FOSTER WHEELER ENVIRONMENTAL TO THE USEPA. THIS DOCUMENT DOES NOT, HOWEVER, REPRESENT USEPA POSITION OR POLICY, AND HAS NOT BEEN FORMALLY RELEASED BY THE USEPA.

USEPA WORK ASSIGNMENT NUMBER: 018-RICO-02GZ USEPA CONTRACT NUMBER: 68-W-98-214 FOSTER WHEELER ENVIRONMENTAL CORPORATION RAC II PROGRAM

FINAL
QUALITY ASSURANCE PROJECT PLAN
FOR
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
CORNELL-DUBILIER ELECTRONICS
SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MARCH 2000

Prepared by.	Approved by.
Xynn E Wills	highard Hills
Lypn Niles	Dev Sachdev, Ph.D., P.E.
Quality Assurance Officer	RAC II Program Manager
Foster Wheeler Environmental	Foster Wheeler Environmental
Reviewed by:	Approved by:
Jon Gabry Ph.D.	Pietro Mannino
RAC II Quality Assurance/Data Quality Manager	Work Assignment Manager
Foster Wheeler Environmental	US Environmental Protection Agency
	Approved by:
	Shari Stevens
	Quality Assurance Officer
	US Environmental Protection Agency

Section No.: 1
Page: i of vi
Revision No.: 1
Date: March 2000

TABLE OF CONTENTS

INTE	RODUCTION	<u>Page</u> 1-1
1.1	SITE LOCATION AND DESCRIPTION	1-2
1.2	SITE HISTORY	
1.3	CURRENT SITE CONDITIONS	
<u>PRO</u>	JECT ORGANIZATION AND PERSONNEL RESPONSIBILITIES	2-1
QUA	ALITY ASSURANCE PROJECT OBJECTIVES	3-1
3.1	DATA QUALITY OBJECTIVE PROCESS	3-1
3.2	APPLICABLE CRITERIA	
	3.2.1 Soils	3-2
	3.2.2 Sediments and Surface Water	3-3
	3.2.3 Building Interior	3-3
	3.2.4 Groundwater	
3.3	DATA QUALITY CATEGORIES	
3.4	QA/QC CHARACTERISTICS	3-18
٥.١		
3.5	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES .	
3.5	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES .	3-22
3.5		3-22
3.5	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES .	3-22
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES . D INVESTIGATION ACTIVITIES	3-22
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES D INVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES	3-22
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES . D INVESTIGATION ACTIVITIES	3-22 4-1 4-2 4-2
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES D INVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey	3-22 4-1 4-1 4-2 4-2 4-2
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey	3-22 4-1 4-1 4-2 4-2 4-2
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing	3-22 4-1 4-1 4-2 4-2 4-2 4-3
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing	3-224-14-14-24-24-24-34-3
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing 4.1.6 Building Interior Sampling [Floor Dust]	3-224-14-14-24-24-24-34-3
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing 4.1.6 Building Interior Sampling [Floor Dust] 4.1.7 Test Pit Investigation 4.1.8 Wetlands and Habitat Delineation	3-224-14-14-24-24-24-34-34-4
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing 4.1.6 Building Interior Sampling [Floor Dust] 4.1.7 Test Pit Investigation 4.1.8 Wetlands and Habitat Delineation 4.1.9 Off-Site Residential/Commercial Property Soil Sampling	3-224-14-14-24-24-24-34-34-44-4
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing 4.1.6 Building Interior Sampling [Floor Dust] 4.1.7 Test Pit Investigation 4.1.8 Wetlands and Habitat Delineation 4.1.9 Off-Site Residential/Commercial Property Soil Sampling 4.1.10 On-Site Surface Soil Sampling	3-224-14-14-24-24-24-34-34-44-4
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing 4.1.6 Building Interior Sampling [Floor Dust] 4.1.7 Test Pit Investigation 4.1.8 Wetlands and Habitat Delineation 4.1.9 Off-Site Residential/Commercial Property Soil Sampling	3-224-14-14-24-24-24-34-34-44-54-5
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing 4.1.6 Building Interior Sampling [Floor Dust] 4.1.7 Test Pit Investigation 4.1.8 Wetlands and Habitat Delineation 4.1.9 Off-Site Residential/Commercial Property Soil Sampling 4.1.10 On-Site Surface Soil Sampling 4.1.11 On-Site Subsurface Soil Sampling 4.1.12 Soil Sample Field Screening	3-224-14-14-24-24-24-34-34-44-54-54-6
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing 4.1.6 Building Interior Sampling [Floor Dust] 4.1.7 Test Pit Investigation 4.1.8 Wetlands and Habitat Delineation 4.1.9 Off-Site Residential/Commercial Property Soil Sampling 4.1.10 On-Site Surface Soil Sampling 4.1.11 On-Site Subsurface Soil Sampling 4.1.12 Soil Sample Field Screening 4.1.13 Hydropunch® Sampling	3-224-14-14-24-24-24-34-34-44-44-54-64-6
3.5 <u>FIEL</u>	IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES DINVESTIGATION ACTIVITIES SAMPLING PROGRAM PROCEDURES 4.1.1 Mobilization and Demobilization 4.1.2 Site Survey 4.1.3 Geophysical Survey 4.1.4 Soil Gas Survey 4.1.5 Dye Testing 4.1.6 Building Interior Sampling [Floor Dust] 4.1.7 Test Pit Investigation 4.1.8 Wetlands and Habitat Delineation 4.1.9 Off-Site Residential/Commercial Property Soil Sampling 4.1.10 On-Site Surface Soil Sampling 4.1.11 On-Site Subsurface Soil Sampling 4.1.12 Soil Sample Field Screening	3-224-14-14-24-24-24-34-34-44-54-54-64-6

Section No.: 1
Page: ii of vi
Revision No.: 1
Date: March 2000

TABLE OF CONTENTS (Cont'd)

			Water Level Measurements	
	4.2	DECC	ONTAMINATION PROCEDURES	4-9
5.0	SAM	PLE CU	STODY AND DOCUMENTATION	5-1
	5.1	SAMF	PLE IDENTIFICATION SYSTEM	5-1
	5.2	SAMF	PLE CUSTODY, PACKAGING AND SHIPPING	5-2
		5.2.1	Field Custody, Packaging and Shipping Procedures	
		5.2.2	Laboratory Custody Procedures	5-6
	5.3	SAMF	PLE DOCUMENTATION	5-7
		5.3.1	Sample Logbook	
		5.3.2	Site and Field Logbooks	5-7
		5.3.3	Field Investigation Forms	5-11
		5.3.4	On-Site Screening Analysis Records	5-11
6.0			AL REQUIREMENTS	
7.0	SUPI	PLIES A	ND CONSUMABLES	/-1
8.0	INST	RUMEN	T CALIBRATION AND PREVENTIVE MAINTENANCE	8-1
	8.1	CALII	BRATION	8-1
		8.1.1	Field Instrumentation	8-1
		8.1.2	Laboratory Instrumentation	
	8.2	PREV	ENTIVE MAINTENANCE	
		8.2.1	Field Instrumentation	
		8.2.2	Laboratory Instrumentation	
9.0	QUA	LITY AS	SSURANCE/QUALITY CONTROL SAMPLE REQUIREMENTS	9 -1
	9.1	FIELD	QUALITY CONTROL SAMPLES	9-1
		9.1.1	Field Blanks	9 -1
		9.1.2	Trip Blanks	9-1
		9.1.3	Deionized Water Blanks	
		9.1.4	Temperature Blanks	
		9.1.5	Field Environmental Duplicate Samples	
	9.2		PRATORY QUALITY CONTROL SAMPLES	

Section No.: 1
Page: iii of vi
Revision No.: 1
Date: March 2000

TABLE OF CONTENTS (Cont'd)

		9.2.1 Method Blanks/Preparation Blanks	. 2-3
		9.2.2 Matrix Spikes/Matrix Spike Duplicates	. 9-3
		9.2.3 <u>Laboratory Control Samples</u>	
		9.2.4 Surrogate Compounds	9-10
		9.2.5 <u>Internal Standards</u>	9-10
		9.2.6 <u>Interference Check Samples</u>	9-10
		9.2.7 <u>Laboratory Duplicate Samples</u>	9-10
10.0	DATA	A REDUCTION, VALIDATION, AND REPORTING	10-1
	10.1	DATA REDUCTION	10-1
		10.1.1 Field Data Reduction	
		10.1.2 <u>Laboratory Data Reduction</u>	10-1
		10.1.3 Project Data Reduction	10-2
		10.1.4 Non-Direct Measurements	10-2
	10.2	DATA VALIDATION	10-2
	10.3	DATA REPORTING	10-3
		10.3.1 Contents of Laboratory Data Reports	10-3
		10.3.2 Contents of Management Reports	10-4
11.0	PERF(ORMANCE AND SYSTEMS AUDITS	11-1
12.0	TRAI	NING OF PROJECT STAFF	12-1
	12.1	GENERAL PERSONNEL TRAINING	12-1
	12.2	QUALITY ASSURANCE TRAINING	12-1
	12.3	TECHNICAL TRAINING	12-1
	12.4	TRAINING RECORDS	12-2
13.0	CORR	RECTIVE ACTION	13-1
14.0	REFE	RENCES	14-1
ATTA	CHMI	ENTS	
Attach	ment 1	Non-RAS Laboratory Procurement Plan	A1-1

Section No.: 1
Page: iv of vi
Revision No.: 1
Date: March 2000

LIST OF TABLES

	<u>F</u>	Page
Table 3-1	Applicable Criteria for Soils	3-4
Table 3-2	Applicable Criteria for Sediments and Surface Water	
Table 3-3	Applicable Criteria for Building Interior	
Table 3-4	Applicable Criteria for Groundwater	
Table 3-5	QA Objectives for Field Investigation Data	
Table 6-1	Summary of Analytical Program - Reconnaissance Phase and	
	Phase I Investigation	
Table 6-2	Sample Collection and Analysis Protocols	6-3
Table 9-1	Summary of Analytical QC Procedure Checks, Frequencies, Acceptance	
	Criteria, and Corrective Actions for Laboratory Sample Analyses	9-4
	LIST OF FIGURES	
	· <u>·</u>	Page
Figure 1-1	Site Location Map	1-3
Figure 1-2	Site Map	
Figure 2-1	Field Investigation Organization Structure	
Figure 5-1	Contract Laboratory Program Chain-of-Custody Form (typical)	5-4
Figure 5-2	Foster Wheeler Environmental Chain-of-Custody Form (typical)	5-5
Figure 5-3	Sample Log Sheet (typical)	5-8
Figure 5-4	Floor Dust Sample Data Sheet (typical)	
Figure 5-5	Boring Log Sheet (typical)	
Figure 5-6	Test Pit Record (typical)	
Figure 5-7	Bedrock Monitoring Well Sheet (typical)	
Figure 5-8	Low-Flow Data Sheet (typical)	
Figure 5-9	Rig Shift Report (typical)	
Figure 5-10	Pumping Test Data Sheet (typical)	
Figure 7-1	Material Received Report (MRR) Form (typical)	
Figure 8-1	Equipment Calibration and Maintenance Form (typical)	
Figure 13-1	Field Change Request (FCR) Form (typical)	13-2
	DISTRIBUTION OF QAPP	
Project Mana	ger - Foster Wheeler Environmental Corporation	
Site QA Offic	cer - Foster Wheeler Environmental Corporation	

RAC II Quality Assurance/Data Quality Manager - Foster Wheeler Environmental Corporation

RAC II Program Manager - Foster Wheeler Environmental Corporation

Work Assignment Manager - US Environmental Protection Agency

QA Officer - US Environmental Protection Agency

Section No.: 1
Page: v of vi
Revision No.: 1
Date: March 2000

ACRONYMS AND ABBREVIATIONS

%R Percent Recovery

AOC Administrative Order on Consent

CLASS Contract Laboratory Analytical Services Support

CLP Contract Laboratory Program

DESA Division of Environmental Science and Assessment

DI Deionized

DOT US Department of Transportation

DQO Data Quality Objective

EHS Environmental Health and Safety
ESS Environmental and Safety Supervisor

FCR Field Change Request
FID Flame Ionization Detector
FOL Field Operations Lead
FOP Field Operations Plan
FSP Field Sampling Plan

ICP Inductively Coupled Plasma
ICS Interference Check Sample
LCS Laboratory Control Sample
MDL Method Detection Limit
MRR Material Received Report
NAPL Non-Aqueous Phase Liquid

NJDEP New Jersey Department of Environmental Protection

Non-RAS Non-Routine Analytical Services

NPL National Priorities List

NTU Nephelometric Turbidity Units

PARCC Precision, Accuracy, Representativeness, Completeness, Comparability

PCB Polychlorinated Biphenyl PID Photoionization Detector

PM Project Manager
QA Quality Assurance

QAPP Quality Assurance Project Plan

QC Quality Control RA Risk Assessment

RAS Routine Analytical Services

RI/FS Remedial Investigation and Feasibility Study

ROD Record of Decision

RPD Relative Percent Difference
RSCC Regional Sample Control Center
RSD Relative Standard Deviation

Section No.: 1
Page: vi of vi
Revision No.: 1
Date: March 2000

SD	Standard Deviation
SLERA	Screening Level Ecological Risk Assessment
SMP	Site Management Plan
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analysis
V.OC	Volatile Organic Compound
WAM	Work Assignment Manager

Section No.: 1
Page: 1 of 7
Revision No.: 1
Date: March 2000

1.0 <u>INTRODUCTION</u>

Presented herein is the Quality Assurance Project Plan (QAPP) for the Remedial Investigation/Feasibility Study (RI/FS) investigation to be undertaken by Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) at the Cornell-Dubilier Electronics Superfund (Cornell-Dubilier) Site. This investigation will provide an adequate database for the selection of a remedy to eliminate, reduce, or control risks to human health and the environment, as per the Work Plan for the Site (FWENC, 2000a).

This QAPP has been prepared to define the quality assurance (QA) and quality control (QC) activities to be implemented, to ensure the integrity of the work to be performed at the Cornell-Dubilier Site, and to ensure that the data collected will be of the appropriate type and quality needed for the intended use. This plan has been prepared and reviewed in accordance with Foster Wheeler Environmental's Corporate Quality Assurance Program (Foster Wheeler Environmental, 1995), Foster Wheeler Environmental's RAC II Program Quality Management Plan (Foster Wheeler Environmental, 1999), Foster Wheeler Environmental's RAC II Program Delivery of Analytical Services Plan (Foster Wheeler Environmental, 1998), and the USEPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (External Review Draft Final) - EPA QA/R-5 (USEPA, 1998).

Specifically, this QAPP addresses the following:

- Description of Project
- Organization and Responsibilities of Project Personnel
- Project Objectives, including Quality Assurance Objectives for Data
- Overview of Field Sampling Program and Procedures
- Sample Packaging and Shipping
- Sample Documentation
- Sample Analytical Program
- Quality Assurance/Quality Control Procedures

Related documents referenced in this QAPP include the Work Plan (Foster Wheeler Environmental, 2000a), the Field Sampling Plan (Foster Wheeler Environmental, 2000b), the Site Management Plan (Foster Wheeler Environmental, 2000c), and the Environmental Health and Safety Plan (Foster Wheeler Environmental, 2000d).

Section No.: 1
Page: 2 of 7
Revision No.: 1

Date: March 2000

1.1 SITE LOCATION AND DESCRIPTION

The Cornell-Dubilier Site is a 25-acre site located at 333 Hamilton Boulevard, in South Plainfield, Middlesex County, New Jersey. The Hamilton Industrial Park, which consists of approximately 15 small industries, currently occupies the Site property. The Site is bordered by Bound Brook and railway tracks to the northeast, Hamilton Boulevard and residential and commercial properties to the northwest, the South Plainfield Department of Public Works property to the southeast, and Spicer Avenue and residential properties to the southwest. A Site Location Map is provided as Figure 1-1, and a Site Plan is presented in Figure 1-2.

1.2 SITE HISTORY

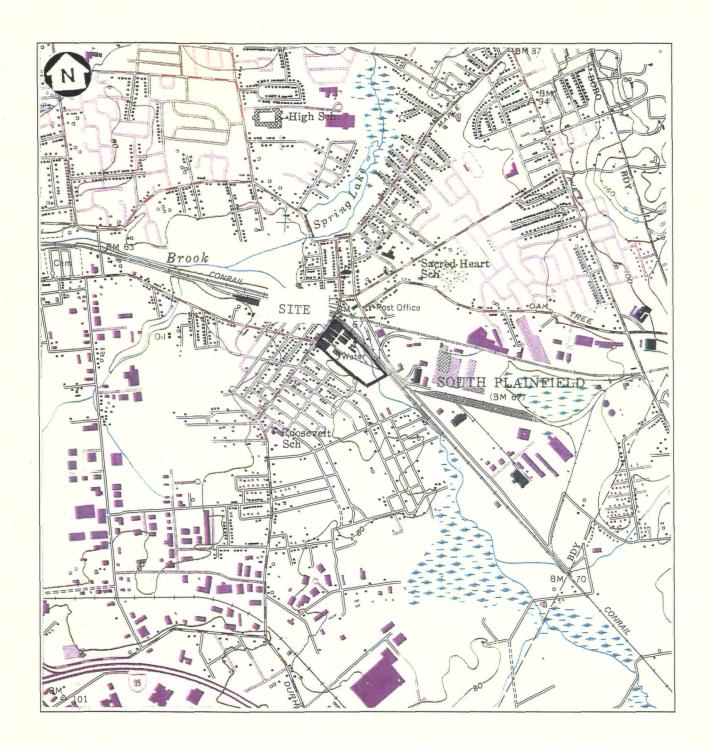
The following presents an overview of the Cornell-Dubilier Site history. Additional, more detailed information is presented in Section 1.2 of the Work Plan.

From 1936 to 1962, Cornell-Dubilier Electronics, Inc. manufactured electronic components, including capacitors, on the Site property. Allegedly, during its operations, the company disposed of transformer oil and other materials contaminated with polychlorinated biphenyls (PCBs) directly onto Site soils. Residual wastes from the on-site processes may also have been landfilled on the Site property, including trichloroethene (TCE), which was used during operations as a degreasing agent.

Personnel from the New Jersey Department of Environmental Protection (NJDEP) visited the Site on March 12, 1985, and noted that an area in the rear of the facility contained black soil. In addition, four large black tanks were present on the edge of a large filled-in area, situated in the rear of the Site. These tanks were at the top of the embankment leading down to Bound Brook.

On September 11, 1986, NJDEP conducted a Site inspection and collected soil, surface water, and sediment samples at the Site. Metals, volatile organic compounds (VOCs) and PCBs were detected in the soil and sediment samples.

The United States Environmental Protection Agency (USEPA) collected surface soil, sediment, and surface water samples from the Site on June 8, 1994. PCBs and various metals were detected at elevated concentrations in the soils. A sediment sample from the stream near the rear of the property contained Aroclor-1254, 1,2-dichloroethene, trichloroethene, and lead. Aroclor-1254, 1,2-dichloroethene, trichloroethene, and lead were also detected in surface water samples, along with Aroclor-1248 and other heavy metals.



SOURCE: US Geological Survey 7.5-minute topographic map for Plainfield, New Jersey.

SCALE: 1: 24 000

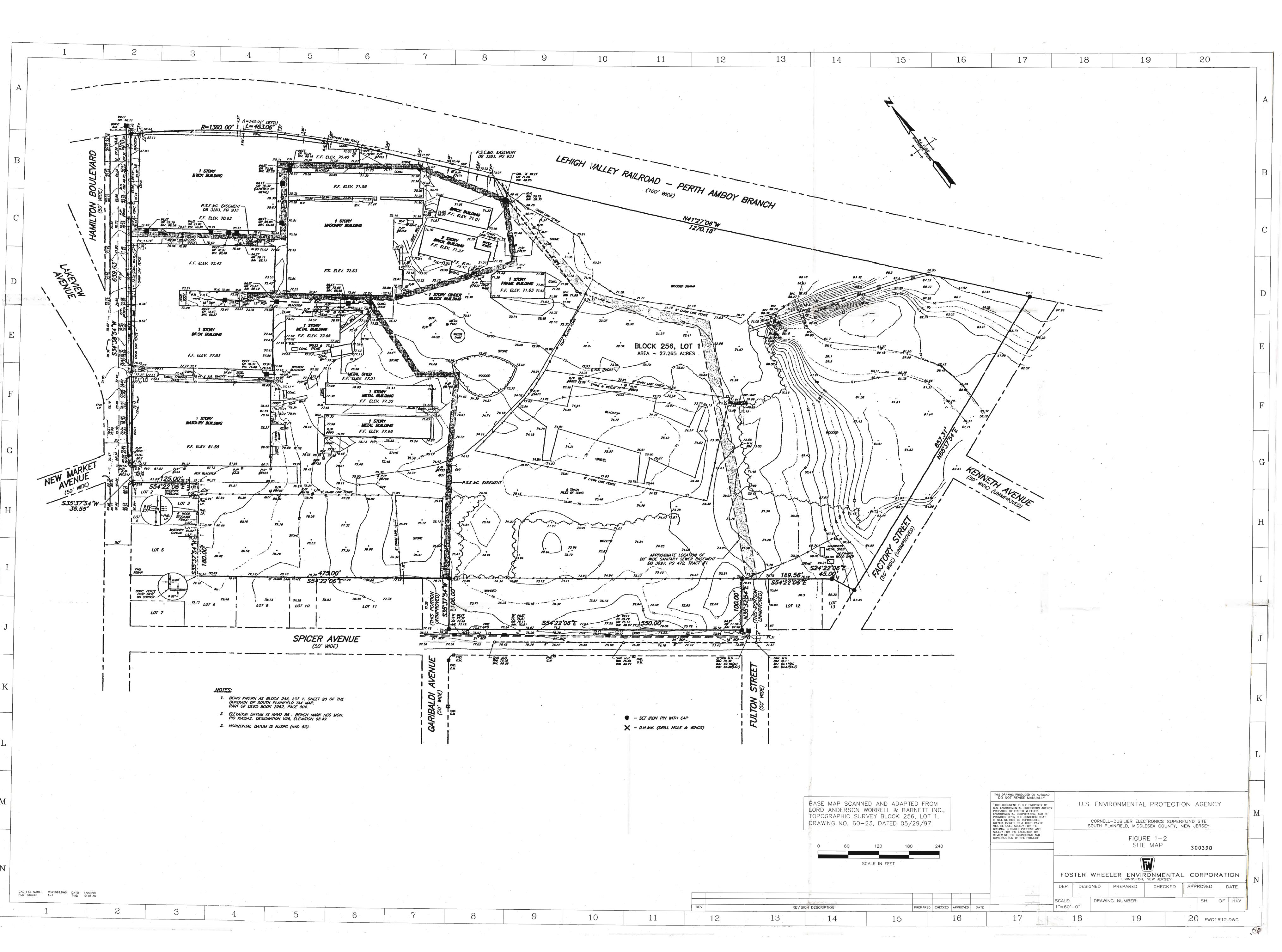
US ENVIRONMENTAL PROTECTION AGENCY

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE

CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, MIDDLESEX COUNTY, NEW JERSEY

FIGURE 1-1 SITE LOCATION MAP

FOSTER WHEELER ENVIRONMENTAL CORPORATION



THIS PAGE WAS INTENTIONALLY LEFT BLANK FOR PAGINATION PURPOSES

Section No.: 1
Page: 5 of 7
Revision No.: 1

Date: March 2000

A screening-level ecological risk assessment was performed by USEPA in June 1996. The assessment indicated that contamination of stream sediments adjacent to the Site, and apparently associated with the Site, were present at levels which have been linked to adverse impacts in benthic organisms.

On June 27 and 29, 1996, USEPA collected additional surface and subsurface soil samples from a roadway, a vacant field, and a foot/bike path on the Site. Surface soil samples contained Aroclor-1254 up to 51,000 mg/kg, and the sample with the maximum concentration was collected near the northeast corner of the fenced area, where electrical and transformer parts were exposed in a swale. Aroclor-1254 was also detected on the surface of the roadway (maximum value: 340 mg/kg) and along the foot/bike path (maximum value: 3,000 mg/kg). In addition, the more elevated concentrations of lead and cadmium were noted in the northeast corner of the fenced area and near the foot/bike path.

Test pits were excavated in the vacant field during July 1996. The test pits revealed stained soils, drum carcasses, electrical parts, mica-like chips, wood, and other debris. Aroclor-1254 and lead were detected in test pit soil samples.

On March 25, 1997, a unilateral administrative order was issued to the owner of the industrial park, which required the paving of facility driveways and parking areas, the installation of security and silt fencing to reduce migration of contaminants, and the posting of warning signs.

In March and June 1997, USEPA conducted building interior sampling (wipe, chip and vacuum) at the Site. Aroclor-1248, Aroclor-1254 and/or weathered Aroclor-1260 were detected in the samples, along with lead and cadmium.

USEPA collected additional samples in June and August 1997, including soil, sediment, water and biota samples. PCBs and four metals were detected in the sediment and flood plain soils. Fish tissue samples contained two PCBs and seven pesticides. NJDEP issued an interim fish consumption advisory for Bound Brook and New Market Pond on August 9, 1997.

Section No.: 1
Page: 6 of 7
Revision No.: 1
Date: March 2000

In October and November 1997, USEPA collected soil and dust samples, respectively, at nearby residential properties (referred to as Tier I). Additional soil sampling activities were conducted in April 1998 (referred to as Tier II) and May 1998 (referred to as Tier III). The interiors of seven Tier I residences, where PCBs were present at levels of potential health concern, were cleaned in April 1998, and sampling of residential interiors were also performed at 36 residences from April 21 through 28, 1998. On November 14, 1998, surface soil samples were again collected from one of the properties along Spicer Avenue (referred to as Addendum to Tier I). Elevated levels of PCBs were noted in soils and dust at several residences located near the Site.

The Cornell-Dubilier Electronics Superfund Site was listed on the federal National Priorities List (NPL) of hazardous waste sites on July 28, 1998.

In August 1998, Cornell-Dubilier Electronics and D.S.C. of Newark, Inc. (the current property owner) entered into an Administrative Consent Order for a removal action which includes removal and disposal of contaminated soil from five residential properties and the delineation of contamination at a sixth. In March 1999, USEPA ordered Cornell-Dubilier Electronics and D.S.C. of Newark, Inc. to conduct a removal action at seven additional residential properties.

In November 1998 and June 1999, USEPA collected additional samples from various locations along Bound Brook. The samples were analyzed for total PCBs, and concentrations ranged from non-detect to 25 ppm.

The Environmental Measurements and Site Assessment Section (EMSA) of NJDEP conducted sediment sampling in Spring Lake and along Cedar Brook from Plainfield High School to the lake in April of 1999. Sediment samples were also collected along a feeder stream from Maple Avenue to Cedar Brook. No PCBs were detected in any of the samples collected. However, alpha- and gamma-chlordane, DDT and DDD were present at concentrations as high as 0.69 ppm.

Between June and July 1999, Environ Corporation conducted a preliminary evaluation of groundwater conditions at the Site. Bedrock was encountered at depths of 6 to 13 feet below ground surface. Trichloroethene and 1,2-dichloroethene were detected at concentrations as high as 29,000 ug/L and 14,000 ug/L, respectively. Aroclor-1254 and Aroclor-1242 were also present, at concentrations ranging up to 14 ug/L and 130 ug/L, respectively.

Section No.: 1
Page: 7 of 7
Revision No.: 1
Date: March 2000

1.3 CURRENT SITE CONDITIONS

Currently, the Hamilton Industrial Park is located in the western portion of the Site, which is largely paved or occupied by buildings. All areas used as driveways, parking areas and walkways were paved by the property owner pursuant to an administrative order issued by USEPA in March 1997. Site control measures including the installation of a six-foot chain-link fence, posting of warning signs, and implementing engineering controls to limit the migration of contaminants through surface water run-off were also instituted pursuant to this order. The western Site area is gently sloping, with elevations ranging from approximately 71 to 81 feet above mean sea level (msl). The middle portion of the Site is primarily an open field, with some wooded areas to the south and a paved area in the fenced area in the center. This area is relatively level, with elevations ranging from approximately 72 to 75 feet above msl. The Site drops steeply to the east, and the eastern portion of the Site consists primarily of a wetland area bordering Bound Brook. Elevations in this area range from approximately 72 feet above msl at the top of the bank to approximately 60 feet above msl along Bound Brook.

Section No.: 2
Page: 1 of 4
Revision No.: 1
Date: March 2000

2.0 PROJECT ORGANIZATION AND PERSONNEL RESPONSIBILITIES

An organization structure has been developed to identify the roles and responsibilities of the various parties involved with the project. The structure for this project includes USEPA, Foster Wheeler Environmental, and several subcontractors (e.g., drilling, surveying, soil gas survey, waste management, and non-Routine Analytical Service (non-RAS) laboratory services). Although QA/QC responsibilities lie principally with the Foster Wheeler Environmental Project Manager and QA Officer, proper implementation of QA/QC requirements necessitate that the entire project staff be cognizant of all procedures and goals. A field investigation organization chart is presented as Figure 2-1.

The Foster Wheeler Environmental team will consist of the following personnel, with a description of their responsibilities:

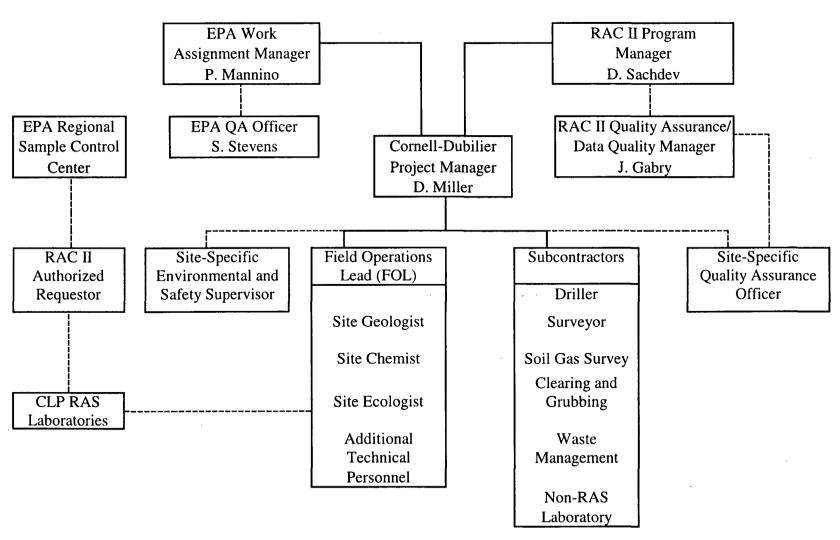
The RAC II **Program Manager**, Dev Sachdev, is responsible for the overall quality of the work performed by Foster Wheeler Environmental under this contract, and has final responsibility and management of the program.

Daniel Miller will be the **Project Manager** (PM) for the Cornell-Dubilier Site. He has primary responsibility and authority for implementing and executing the technical, QA and administrative aspects of the RI/FS investigation, including the overall management of the project team. The PM is accountable for ensuring that the investigation is conducted in accordance with applicable plans and guidelines, including the Work Plan, the Field Sampling Plan (FSP), the Site Management Plan (SMP), the QAPP, and the Environmental Health and Safety Plan (EHS Plan). In addition, the PM will communicate all technical, QA and administrative matters to the USEPA Work Assignment Manager (WAM). He will ensure that any deviations from the approved Work Plan, FSP, SMP, QAPP, and/or EHS Plans are documented in Field Change Request (FCR) forms, communicated to the USEPA WAM, and approved. The PM has the responsibility for overseeing the preparation of project deliverables to be submitted by Foster Wheeler Environmental.

The overall management of the activities to ensure the quality of work associated with the project is the responsibility of the RAC II Quality Assurance/Data Quality Manager, Jon Gabry. A site-specific QA Officer will be assigned to the Cornell-Dubilier project, to hold responsibility for on-site QA activities, including performance of audits and verification of corrective actions. In addition,

Section No.: 2 Page: 2 of 4 Revision No: 1 Date: March 2000

FIGURE 2-1
FIELD INVESTIGATION ORGANIZATION STRUCTURE



Section No.: 2 Page: 3 of 4 Revision No.: 1

Date: March 2000

the OA Officer will coordinate with the PM, the Site Chemist and other project staff, as applicable, during the reduction, review and reporting of the analytical data.

The Field Operations Lead (FOL) will be responsible for the management and supervision of the field investigation program, providing consultation and decision-making on day-to-day issues relating to the sampling activities. The FOL shall monitor the sampling to determine that operations are consistent with plans and procedures, and that the data acquired meets the analytical and data quality needs. When necessary, the FOL will document any deviations from the plans and procedures for approval.

The Site Chemist/Sample Coordinator is responsible for overseeing the collection, packaging, preservation and shipping procedures for the investigation samples and ensuring that these procedures are performed in accordance with applicable plans and guidelines. Also, the Site Chemist is responsible for the review, tabulation and analysis of the data results, in conjunction with the PM, the QA Officer, the Site Geologist, and other applicable personnel.

The Site Geologist shall be responsible for the geological and hydrogeological field investigation at the Site. In addition, the analysis and evaluation of the field data will be the responsibility of the Site Geologist.

The **Site Ecologist** is responsible for the ecological field investigation at the Site, including collection of biota and toxicity samples. He is also responsible for the analysis and evaluation of the data results for the ecological risk assessment.

The site-specific Environmental and Safety Supervisor (ESS) reports to Foster Wheeler Environmental Health and Safety Management, and is responsible for the implementation of the sitespecific EHS Plan. The ESS shall advise the project staff on health and safety issues, conduct health and safety training sessions, and monitor the effectiveness of the health and safety program conducted in the field. The ESS, acting for the safety of all Site personnel, has the authority to stop work during the field activities.

In addition, other technical sampling team members may provide support to the PM and the FOL on an as-needed basis.

Section No.: 2
Page: 4 of 4
Revision No.: 1
Date: March 2000

The services of several subcontractors (e.g., drilling, surveying, soil gas survey, waste management, and non-RAS laboratory services) will also be necessary for the performance of the field investigation. Attachment 1 provides an overview of the Foster Wheeler Environmental procurement plan for non-RAS laboratories. Greater details concerning non-RAS laboratory procurement are specified in the RAC II Program Delivery of Analytical Services Plan (Foster Wheeler Environmental, 1998). The PM, with assistance from the FOL, the Quality Assurance/Data Quality Manager and the Site Chemist as necessary and appropriate, will be the liaison between Foster Wheeler Environmental, the USEPA and each of the subcontractors.

In addition, RAS laboratory services will be needed during the field investigation. The Foster Wheeler Environmental RAC II Authorized Requestor will coordinate with the PM on the number and type of RAS samples necessary. The sample cases will be requested through the USEPA Regional Sample Control Center (RSCC), to the Contract Laboratory Analytical Services Support (CLASS) office, as per the Contract Laboratory Program (CLP).

Section No.: 3
Page: 1 of 22
Revision No.: 1
Date: March 2000

3.0 QUALITY ASSURANCE PROJECT OBJECTIVES

The objective of the field investigation for the Cornell-Dubilier Site is to obtain sufficient data at a known quality level for the selection of a remedy to eliminate, reduce, or control risks to human health and the environment, through the performance of human health and ecological risk assessments and a feasibility study.

3.1 DATA QUALITY OBJECTIVE PROCESS

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions during remedial activities. DQOs can be defined as what the end user expects to obtain from the analysis results, and are developed through a seven-step process:

•	Step 1	State the problem
•	Step 2	Identify the decision
•	Step 3	Identify inputs to the decision
•	Step 4	Define the study boundaries
•	Step 5	Develop a decision rule
•	Step 6	Specify limits on decision errors
•	Step 7	Optimize the decision for obtaining data

For the Cornell-Dubilier Site, screening data generated by rapid, less precise methods of analysis will achieve a data use for site characterization and monitoring. Definitive laboratory analytical data generated during the field investigation will achieve a data use to support a risk assessment.

Specifically, these data will be used to:

Confirm and further define the nature and extent of surface and subsurface soil
contamination, through the comparison of constituent results to applicable criteria
and the development of isoconcentration maps;

Section No.: 3
Page: 2 of 22
Revision No.: 1

Date: March 2000

- Confirm and further define (as necessary) the nature and extent of sediment and surface water contamination, through the comparison of constituent results to applicable criteria and the development of isoconcentration maps;
- Confirm and further define (as necessary) the nature and extent of biota contamination, through the comparison of constituent results to applicable criteria;
- Confirm and further define the nature and extent of building interior contamination, through the comparison of constituent results to applicable criteria;
- Define the nature and extent of groundwater contamination, through the comparison of constituent results to applicable criteria and the development of isoconcentration maps;
- Obtain sufficient data (i.e., greater than or equal to 90 percent complete; see Section 3.3) for the performance of Human Health and Ecological risk assessments; and
- Obtain sufficient data (i.e., greater than or equal to 90 percent complete; see Section 3.3) for the screening and evaluation of appropriate remedial alternatives during the Feasibility Study.

Known contaminants present in samples collected from the Site and the nearby vicinity include chlorinated solvents (e.g., trichloroethene); polycyclic aromatic hydrocarbons (e.g., phenanthrene, benzo(a)pyrene); pesticides (e.g., chlordane); PCBs (e.g., Aroclor-1254); and metals (e.g., cadmium, lead). The principal contaminants of concern at the Cornell-Dubilier Site are PCBs (especially Aroclor-1254).

3.2 APPLICABLE CRITERIA

The benchmark comparison criteria to be used during interpretation of the nature and extent of contamination will include applicable or relevant and appropriate requirements (ARARs), i.e., standards promulgated under federal or state law, and "to be considered" (TBC) guidance values, which are not promulgated. Sections 3.2.1 through 3.2.4 define the specific benchmark criteria for comparison for the various matrices at the Site.

3.2.1 Soils

Currently, USEPA has developed Generic Soil Screening Levels (SSLs), using default values in the standardized equations (USEPA, 1996). There are Generic SSLs for both direct ingestion of soil and

Section No.: 3
Page: 3 of 22
Revision No.: 1

Date: March 2000

inhalation of volatiles. In addition, NJDEP has Soil Cleanup Criteria for direct contact and impact to groundwater (NJDEP, 1999). Values are provided on Table 3-1.

3.2.2 Sediments and Surface Water

Results of the sediment sampling will be compared, as applicable, to severe effect level values presented in NJDEP Guidance for Sediment Quality Evaluation (NJDEP, 1998). Certain criteria values are given in units of mass of compound per unit of mass of total organic carbon, and will be "normalized" to the amount of total organic carbon in the sediments prior to comparison. Sediment criteria are provided on Table 3-2.

USEPA Water Quality Criteria (USEPA, 1999) and NJDEP Surface Water Quality Standards (NJDEP, 1997) will be used as comparisons for the surface water data, as applicable, and these values are provided on Table 3-2. For the USEPA values, the lower of the freshwater "criterion maximum concentration" and "criterion continuous concentration" (denoted in freshwater column) and the lower of "water and organism" and "organism" values (denoted in human health column) were chosen. The NJDEP values shown are those for protection of human health and the lower value for the acute or chronic protection of aquatic life.

3.2.3 Building Interior

NJDEP has instituted building interior surface cleanup standards, on a mass per area basis, for five metals (antimony, arsenic, cadmium, lead, and mercury) and for total PCBs (NJAC 7:26D-22). The analytical results from the floor dust samples being collected during the investigation, which will also be in mass per area, will be compared to the values from the floor to 6 feet, non-window surfaces. Values are provided on Table 3-3.

Currently NJDEP has instituted building interior air cleanup criteria only for mercury (see Table 3-3).

3.2.4 Groundwater

As indicated in Table 3-4, groundwater results will be compared to Maximum Contaminant Levels (MCLs) found in USEPA Drinking Water Regulations and Health Advisories (USEPA, 1996) and

TABLE 3-1 (Sheet 1 of 3)

APPLICABLE CRITERIA FOR SOILS

Constituents	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact	NJDEP Soil Cleanup Criteria Impact to Groundwater	USEPA Generic Soil Screening Levels (SSLs) Direct Ingestion	USEPA Generic Soil Screening Levels (SSLs) Inhalation	USEPA Generic SSI Migration to Groundwater 1/20 DAF	
Volatile Organics						
Dichlorodifluoromethane	-	-		-	-/-	
Chloromethane	1,000	10	-	-	-/-	
Vinyl Chloride	7	10	0.3	0.03	0.0007 / 0.01	
Bromomethane	1,000	1	110	10	0.01 / 0.2	
Chloroethane	-	-	-	-	-/-	
Trichlorofluoromethane	-	-	-	<u>-</u>	-/-	
1,1-Dichloroethene	150	10	1	0.07	0.003 / 0.06	
1,1,2-Trichloro-1,2,2-trifluoroethane	-	-	-	-	-/-	
Acetone	1,000	100	7,800	1.0 e+5	0.8 / 16	
Carbon Disulfide	-	-	7,800	720	2/32	
Methyl Acetate	-	-	-	-	-1-	
Methylene Chloride	210	-	85	13	0.001 / 0.02	
trans-1,2-Dichloroethene	1,000	50	1,600	3,100	0.03 / 0.7	
Methyl tert-Butyl Ether	-	-	-		-/-	
1,1-Dichloroethane	1,000	10	7,800	1,300	1 / 23	
cis-1,2-Dichloroethene	1,000	1	780	1,200	0.02 / 0.4	
2-Butanone	1,000	50	-	-	-/-	
Chloroform	28	1	100	0.3	0.03 / 0.6	
1,1,1-Trichloroethane	-	-	. •	1,200	0.1/2	
Cyclohexane	-	-	•	•	-/-	
Carbon Tetrachloride	4	1	5	0.3	0.003 / 0.07	
Benzene	13	1	22	0.8	0.002 / 0.03	
1,2-Dichloroethane	24	1	7	0.4	0.001 / 0.02	
Trichloroethene	54	1	58	5	0.003 / 0.06	
Methylcyclohexane	-	-	-	-	-1-	
1,2-Dichloropropane	43	•	9	15	0.001 / 0.03	
Bromodichloromethane	46	1	10	3,000	0.03 / 0.6	
cis-1,3-Dichloropropene	5	1	4	0.1	0.0002 / 0.004	
4-Methyl-2-Pentanone	1,000	50	•	-	-/-	
Toluene	1,000	500	16,000	650	0.6 / 12	
trans-1,3-Dichloropropene	5	1	4	0.1	0.0002 / 0.004	
1,1,2-Trichloroethane	420	1	11	1	0.0009 / 0.02	
Tetrachloroethene	6	1	12	11	0.003 / 0.06	
2-Hexanone	-	-	-	-	-/-	
Dibromochloromethane	1,000	1	8	1,300	0.02 / 0.4	
1,2-Dibromoethane	-	•	•	•	-/-	
Chlorobenzene	680	1	1,600	130	0.07 / 1	
Ethylbenzene	1,000	100	7,800	400	0.7 / 13	
Xylenes (total)	1,000	67	1.6 e+5	410	9 / 190	
Styrene	97	100	16,000	1,500	0.2 / 4	
Bromoform	370	1	81	53	0.04 / 0.8	
Isopropylbenzene	•	•	-	-	-/-	
1,1,2,2-Tetrachloroethane	70	1	3	0.6	0.0002 / 0.003	
1,3-Dichlorobenzene	10,000	100	-	-	-/-	
1,4-Dichlorobenzene	10,000	100	27	-	0.1/2	
1,2-Dichlorobenzene	10,000	50	7,000	560	0.9 / 17	
1,2-Dibromo-3-chloropropane	-	•	-	-	-1-	
1,2,4-Trichlorobenzene	1,200	100	780	3,200	0.3 / 5	
Semi-Volatile Organics						
Benzaldehyde			-	•	-/-	
Phenol	10,000	50	47,000	•	5 / 100	
bis(2-Chloroethyl) ether	3	10	0.6	0.2	2 e-5 / 0.0004	
2-Chlorophenol	5,200	10	390	53,000	0.2 / 4	
2-Methylphenol	10,000	-	3,900		0.8 / 15	
2,2'-oxybis(1-Chloropropane)	10,000	10		-	-1-	
Acetophenone		-	-	-	-/-	
4-Methylphenol	10,000		I	i	-/-	

TABLE 3-1 (Sheet 2 of 3)

APPLICABLE CRITERIA FOR SOILS

Constituents	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact	NJDEP Soil Cleanup Criteria Impact to Groundwater	USEPA Generic Soil Screening Levels (SSLs) Direct Ingestion	USEPA Generic Soil Screening Levels (SSLs) Inhalation	USEPA Generic SSLs Migration to Groundwater 1/20 DAF
Semi-Volatile Organics (Cont'd)					
N-Nitroso-di-n-propylamine	0.66	10			2 e-6 / 5 e-5
Hexachloroethane	100	100	46	55	0.02 / 0.5
Nitrobenzene	520	10	39	92	0.007 / 0.1
Isophorone	10,000	50	670	4,600	0.03 / 0.5
2-Nitrophenol	-	-	-	-	-/-
2,4-Dimethylphenol	10,000	10	1,600	-	0.4 / 9
bis(2-Chloroethoxy)methane	-	-	-	-	-/-
2,4-Dichlorophenol	3,100	10	230	-	0.05 / 1
Naphthalene	4,200	100	3,100	-	4 / 84
4-Chloroaniline	4,200		310	-	0.03 / 0.7
Hexachlorobutadiene	21	100	•	•	-/-
Caprolactam	-	<u>-</u>	-	-	-/-
4-Chloro-3-methylphenol	-	-	-	-	-/-
2-Methylnaphthalene	-	-	-	-	-1-
Hexachlorocyclopentadiene	7,300	100	550	10	20 / 400
2,4,6-Trichlorophenol	270	10	58	200	0.008 / 0.2
2,4,5-Trichlorophenol	10,000	50	7,800	-	14 / 270
1,1'-Biphenyl	-		-	-	-1-
2-Chloronaphthalene	-	-	-	-	-/-
2-Nitroaniline	-		· -	-	-/-
Dimethylphthalate	10,000	50	-	-	-/-
2,6-Dinitrotoluene	4	10	0.9		3 e-5 / 0.0007
Acenaphthylene	•	-	-	-	-/-
3-Nitroaniline	-	-	-	-	-/-
Acenaphthene	10,000	100	4,700	-	29 / 570
2,4-Dinitrophenol	4	10	160	-	0.01 / 0.3
4-Nitrophenol	-	-	-		-1
Dibenzofuran	-	-	-		-1-
2,4-Dinitrotoluene	2,100	10	0.9	-	4 e-5 / 0.0008
Diethylphthalate	10,000	50	63,000	2,000	23 / 470
Fluorene	10,000	100	3,100	-	28 / 560
4-Chlorophenyl-phenylether	-	-	-	-	-/-
4-Nitroaniline	-	-	-	-	-/-
4,6-Dinitro-2-methylphenol	-	-	-	-	-/-
N-Nitrosodiphenylamine	600	100	130	-	0.06 / 1
4-Bromophenyl-phenylether	-	-	-	-	-/-
Hexachlorobenzene	2	100	0.4	1	0.1 / 2
Atrazine	-	-	-		-/-
Pentachlorophenol	24	100	3	-	0.001 / 0.03
Phenanthrene	-	-	-	-	-/-
Anthracene	10,000	100	23,000	-	590 / 12,000
Carbazole	-	-	32	-	0.03 / 0.6
Di-n-butylphthalate	10,000	100	7,800	2,300	270 / 2,300
Fluoranthene	10,000	100	3,100	-	210 / 4,300
Pyrene	10,000	100	2,300		210 / 4,200
Butylbenzylphthalate	10,000	100	16,000	930	810 / 930
3,3'-Dichlorobenzidine	6	100	1	1 -	0.0003 / 0.007
Benzo(a)anthracene	4	500	0.9		0.08 / 2
Chrysene	40	500	88] _	8 / 160
bis(2-Ethylhexyl)phthalate	210	100	46	31,000	180 / 3,600
Di-n-octylphthalate	10,000	100	1,600	10,000	10,000 / 10,000
Benzo(b)fluoranthene	4	50	0.9	10,000	0.2/5
Benzo(k)fluoranthene	4	500	9	1 .	2/49
Benzo(a)pyrene	0.66	100	0.09] .	0.4 / 8
Indeno(1,2,3-cd)pyrene	4	500	0.09	1	0.4 / 8
Dibenz(a,h)anthracene	0.66	100	0.09	1	•
Benzo(g,h,i)perylene	0.00	100	0.09	1	0.08 / 2
	+		 	 	-/-
Pesticides/PCBs					
alpha-BHC	-	· -	0.1	0.8	3e-5 / 0.0005

TABLE 3-1 (Sheet 3 of 3)

APPLICABLE CRITERIA FOR SOILS

Constituents	NJDEP Soil	NJDEP Soil	USEPA Generic Soil Screening	USEPA Generic Soil Screening	USEPA Generic SS Migration to
Constituents	Cleanup Criteria Non-Residential	Cleanup Criteria Impact to		Levels (SSLs)	Groundwater
	Direct Contact	Impact to Groundwater	Levels (SSLs) Direct Ingestion	Inhalation	1 / 20 DAF
D-4-11- (C-411)	Direct Contact	Groundwater	Direct Ingestion	imatation	1720 DAF
Pesticides (Cont'd)		i	i	ì	-/-
delta-BHC	-	-	-	,	•
gamma-BHC (Lindane)	2	50	0.5		0.0005 / 0.009
Heptachlor	0.65	50	0.1	4	1 / 23
Aldrin	0.17	50	0.04	3	0.02 / 0.5
Heptachlor epoxide	-	1 :	0.07	5	0.03 / 0.7
Endosulfan I	6200	50	470		0.9 / 18
Dieldrin	0.18	50	0.04	1	0.0002 / 0.004
4,4'-DDE	9	50	2	•	3 / 54
Endrin	310	50	23		0.05 / 1
Endosulfan II	6200	50	470		0.9 / 18
4,4'-DDD	12	50	3	•	0.8 / 16
Endosulfan sulfate	-	-	-	-	-/-
4,4'-DDT	9	500	2	-	2/32
Methoxychlor	5200	50	390	1 -	8 / 160
Endrin ketone	_	<u>-</u>			-/-
Endrin aldehyde	-				-1-
alpha-Chlordane	i .	-	0.5	20	0.5 / 10
gamma-Chlordane	_	<u>-</u>	0.5	20	0.5 / 10
Toxaphene	0.2	50	0.6	89	2/31
Aroclor-1016	2 *	50 *	1*	"_	-/-
Aroclor-1010	2*	50 *	1*		-/-
Aroclor-1221 Aroclor-1232	2 *	50 *	1*	· -	-/-
	-	ľ	1*		-/-
Aroclor-1242	2 *	50 *		1 -	I '
Aroclor-1248	2 *	50 *	1*	-	-/-
Aroclor-1254	2 *	50 *]*	-	-/-
Aroclor-1260	2 *	50 *	1 *		-/-
Metals and Cyanide		ļ		į.	
Aluminum	-	-	-		-/-
Antimony	340	SS	31	-	0.3 / 20
Arsenic	20	SS	0.4	750	1 / 29
Barium	47,000	SS	5,500	6.9 e+5	82 / 1600
Beryllium	2	ss	0.1	1,300	3 / 63
Cadmium	100	ss	78	1,800	0.4 / 8
Calcium	_		-	_	-/-
Chromium	6100 / 20	ss	390	270	2/38
Cobalt		<u>-</u>	_		-/-
Copper	600	SS	l <u>-</u>	-	-/-
Iron	1	-	_	l .	-/-
Lead	600	l ss	400	_	-/-
Magnesium	-	55	-	_	-/-
Manganese			<u>-</u>	_	-/-
Mercury	270		·	· -	-/-
-	270	SS	-	12.000	l .
Nickel	2,400	SS	1,600	13,000	7 / 130
Potassium				-	-/-
Selenium	3,100	SS	390	j -	0.3 / 5
Silver	4,100	SS	390	-	2/34
Sodium		-	-	-	-1-
Thallium	2	ss	-	-	0.04 / 0.7
Vanadium	7,100	SS	550] -	300 / 6,000
Zinc	1,500	SS	2,300	1 -	620 / 12,000
Cyanide	21,000	SS	1,600	1	2 / 40

Notes:
DAF = Dilution Attenuation Factor

SS = Site-specific

All soil criteria values are provided in mg/kg.

300412

^{- =} No criteria available

^{* =} Criteria value corresponds to sum of all PCBs.

TABLE 3-2 (Sheet 1 of 5)

APPLICABLE CRITERIA FOR SEDIMENTS AND SURFACE WATERS

Constituents	NJDEP Guidance for Sediment Quality Evaluation		Constituents	NJDEP Surface Water Quality Standards (Aquatic)	NJDEP Surface Water Quality Standards (Human Health)	USEPA Water Quality Criteria (Freshwater)	USEPA Water Quality Criteria (Human Health)
Volatile Organics			Volatile Organics				
Dichlorodifluoromethane	-		Chloromethane	-	-	-	-]
Chloromethane	-		Bromomethane	-	48	-	48
Vinyl Chloride	•		Vinyl Chloride	-	0.083	-	2
Bromomethane	-		Chloroethane	-		-	-
Chloroethane	-		Methylene Chloride	-	2.49	-	4.7
Trichlorofluoromethane	-		Acetone	-	-	-	· -
1,1-Dichloroethene	-		Carbon Disulfide	-	-	-	-
1,1,2-Trichloro-1,2,2-trifluoroethane	-		1,1-Dichloroethene	-	0.57	-	0.057
Acetone			1,1-Dichloroethane	-	-	-	0.38
Carbon Disulfide	-		cis-1,2-Dichloroethene	-	-	-	-
Methyl Acetate	.		trans-1,2-Dichloroethene	-	592	-	700
Methylene Chloride	-		Chloroform	-	5.67	-	5.7
trans-1,2-Dichloroethene	- [1,2-Dichloroethane	-	0.291	-	- 1
Methyl tert-Butyl Ether	-		2-Butanone	-	-	-	- 1
1,1-Dichloroethane] .]		Bromochloromethane	-	-	-	-
cis-1,2-Dichloroethene	-		1,1,1-Trichloroethane		127	-	- [
2-Butanone	-		Carbon Tetrachloride	-	0.25	-	0.25
Chloroform	-		Bromodichloromethane	-	0.266	-	0.56
1,1,1-Trichloroethane	-	•	1,2-Dichloropropane	-	-	<u>-</u>	- [
Cyclohexane	-		cis-1,3-Dichloropropene	-	0.193	-	10
Carbon Tetrachloride	- }		Trichloroethene	-	1.09		2.7
Benzene	0.34		Dibromochloromethane	-	4.1	-	0.41
1,2-Dichloroethane	-		1,1,2-Trichloroethane	-	6	<u>-</u>	0.6
Trichloroethene	1.6		Benzene	-	0.15	-	1.2
Methylcyclohexane	-		trans-1,3-Dichloropropene	-	0.193	-	10
1,2-Dichloropropane	-		Bromoform	-	4.3	_	4.3
Bromodichloromethane	- 1		4-Methyl-2-Pentanone	-	-	_	-
cis-1,3-Dichloropropene	-		2-Hexanone	-	-	-	-
4-Methyl-2-Pentanone	-		Tetrachloroethene	-	0.388	_	0.8
Toluene	2.5		1,1,2,2-Tetrachloroethane	-	1.7	-	0.17
trans-1,3-Dichloropropene	-		1,2-Dibromoethane	-	.	_	-
1,1,2-Trichloroethane	-		Toluene		6800	<u>-</u>	6800

APPLICABLE CRITERIA FOR SEDIMENTS AND SURFACE WATERS

Constituents	NJDEP Guidance for Sediment Quality Evaluation
Volatile Organics (Cont'd)	
Tetrachloroethene	0.45
2-Hexanone	-
Dibromochloromethane	-
1,2-Dibromoethane	-
Chlorobenzene	-
Ethylbenzene	1.4
Xylenes (total)	>0.12
Styrene	-
Bromoform	-
Isopropylbenzene	-
1,1,2,2-Tetrachloroethane	-
1,3-Dichlorobenzene	-
1,4-Dichlorobenzene	
1,2-Dichlorobenzene	-
1,2-Dibromo-3-chloropropane	•
1,2,4-Trichlorobenzene	
Semi-Volatile Organics	
Benzaldehyde	-
Phenol	-
bis(2-Chloroethyl) ether	-
2-Chlorophenol	-
2-Methylphenol	-
2,2'-oxybis(1-Chloropropane)	-
Acetophenone	-
4-Methylphenol	-
N-Nitroso-di-n-propylamine	-
Hexachloroethane	-
Nitrobenzene	-
Isophorone	1 -
2-Nitrophenol	-
2,4-Dimethylphenol	-
bis(2-Chloroethoxy)methane	

	NJDEP	NJDEP	USEPA	USEPA
	Surface	Surface	Water	Water
Constituents	Water Quality	Water Quality	Quality	Quality
Constituents	Standards	Standards	Criteria	Criteria
	(Aquatic)	(Human Health)	(Freshwater)	(Human Health)
Volatile Organics (Cont'd)	(riquatie)	(Human Health)	(Freshwater)	(Human Health)
Chlorobenzene	,	22	_	680
Ethylbenzene		3030		3100
Styrene	l <u>-</u>	-	_	- 5100
Xylenes (total)	<u> </u>	_	_	_
1,3-Dichlorobenzene		400	_	400
1,4-Dichlorobenzene	_	343	_	400
1,2-Dichlorobenzene		2520	_	2700
1,2-Dibromo-3-chloropropane		2320		2700
1,2,4-Trichlorobenzene	_	30.6	_	260
Semi-Volatile Organics		30.0	<u> </u>	200
Phenol		20900		21000
bis(2-Chloroethyl) ether	_	0.031		0.031
2-Chlorophenol	-	122	_	120
2-Methylphenol	-	122	_	120
2,2'-oxybis(1-Chloropropane)	-	1250	-	1400
4-Methylphenol	-	1230	-	1400
1	· -	_		0.005
N-Nitroso-di-n-propylamine Hexachloroethane	-	-	-	0.005
	-	-	-	1.9
Nitrobenzene	16	-	-	17
Isophorone	-	84	-	36
2-Nitrophenol	-	-	-	
2,4-Dimethylphenol	-	-	-	540
bis(2-Chloroethoxy)methane	-	- 02.7	-	-
2,4-Dichlorophenol	-	92.7	-	93
Naphthalene	-	-	<u>-</u>	-
4-Chloroaniline	-	-	-	
Hexachlorobutadiene	-	4.4	-	0.44
4-Chloro-3-methylphenol	-	-	-	<u> </u>
2-Methylnaphthalene	-	-	-	1
Hexachlorocyclopentadiene	-	240	-	240
2,4,6-Trichlorophenol	-	2.1	<u>-</u>	2.1
2,4,5-Trichlorophenol		2580	-	2600

TABLE 3-2 (Sheet 3 of 5)

APPLICABLE CRITERIA FOR SEDIMENTS AND SURFACE WATERS

	l waren l		NIDED	Nunen	HOPPA	VIGDD.
	NJDEP		NJDEP	NJDEP	USĒPĀ	USEPA
	Guidance		Surface	Surface	Water	Water
Constituents	for Sediment	Constituents	Water Quality	Water Quality	Quality	Quality
	Quality	1	Standards	Standards	Criteria	Criteria
	Evaluation		(Aquatic)	(Human Health)	(Freshwater)	(Human Health)
Semi-Volatile Organics (Cont'd)		Semi-Volatile Organics (Cont'd)		ľ	1	
2,4-Dichlorophenol	-	2-Chloronaphthalene	-	-	-	1700
Naphthalene	ļ - ļ	2-Nitroaniline	-	-	-	-
4-Chloroaniline	-	Dimethylphthalate	-	313000	-	313000
Hexachlorobutadiene	-	Acenaphthylene	-	-	-	-
Caprolactam	- 1	2,6-Dinitrotoluene	-	-	-	-
4-Chloro-3-methylphenol	-	3-Nitroaniline	-	-	-	-
2-Methylnaphthalene	J - J	Acenaphthene	-	-	-	1200
Hexachlorocyclopentadiene	-	2,4-Dinitrophenol	-	69.7	_	70
2,4,6-Trichlorophenol	-	4-Nitrophenol	-	-	-	-
2,4,5-Trichlorophenol	-	Dibenzofuran	-	-	-	-
1,1'-Biphenyl	-	2,4-Dinitrotoluene	-	0.11	-	0.11
2-Chloronaphthalene	-	Diethylphthalate	-	21200	-	23000
2-Nitroaniline	-	4-Chlorophenyl-phenylether	-	-	-	-
Dimethylphthalate	-	Fluorene	-	1300	-	1300
2,6-Dinitrotoluene	-	4-Nitroaniline	-	-	J -	-
Acenaphthylene	-	4,6-Dinitro-2-methylphenol	-	13.4	-	13.4
3-Nitroaniline	-	N-Nitrosodiphenylamine	-	4.95	-	5
Acenaphthene	- 1	4-Bromophenyl-phenylether	-	-	-	-
2,4-Dinitrophenol	-	Hexachlorobenzene		0.000748	-	0.00075
4-Nitrophenol] -]	Pentachlorophenol	13	0.28	15	0.28
Dibenzofuran	-	Phenanthrene	-	-	_	-
2,4-Dinitrotoluene	-	Anthracene	-	9570	_	9600
Diethylphthalate	- 1	Di-n-butylphthalate	-	2700	-	2700
Fluorene	160	Fluoranthene	-	300	-	300
4-Chlorophenyl-phenylether] -]	Pyrene	-	797	-	960
4-Nitroaniline	-	Butylbenzylphthalate	<u>-</u> '	239	-	3000
4,6-Dinitro-2-methylphenol	- 1	3,3'-Dichlorobenzidine	-	0.0386	_	0.04
N-Nitrosodiphenylamine	- 1	Benzo(a)anthracene	-	0.0028		0.0044
4-Bromophenyl-phenylether	-	Chrysene	-	0.0028	_	0.0044
Hexachlorobenzene	- 1	bis(2-Ethylhexyl)phthalate	-	1.76	-	1.8
Atrazine	-	Di-n-octylphthalate	-	-	-	-
Pentachlorophenol	-	Benzo(b)fluoranthene	-	0.0028	-	0.0044
Phenanthrene	950	Benzo(k)fluoranthene	-	0.0028	-	0.0044
Anthracene	370	Benzo(a)pyrene	-	0.0028	-	0.0044

	NJDEP
	Guidance
G	-
Constituents	for Sediment
	Quality
	Evaluation
Semi-Volatile Organics (Cont'd)	
Carbazole	-
Di-n-butylphthalate	-
Fluoranthene	1020
Pyrene	850
Butylbenzylphthalate	-
3,3'-Dichlorobenzidine	-
Benzo(a)anthracene	1480
Chrysene	460
bis(2-Ethylhexyl)phthalate	-
Di-n-octylphthalate	-
Benzo(b)fluoranthene	-
Benzo(k)fluoranthene	1340
Benzo(a)pyrene	1440
Indeno(1,2,3-cd)pyrene	320
Dibenz(a,h)anthracene	130
Benzo(g,h,i)perylene	320
Pesticides/PCBs	
alpha-BHC	10
beta-BHC	21
delta-BHC	-
gamma-BHC (Lindane)	1
Heptachlor	-
Aldrin	8
Heptachlor epoxide	5
Endosulfan I	-
Dieldrin	91
4,4'-DDE	19
Endrin	130
Endosulfan II	-
4,4'-DDD	6
Endosulfan sulfate	-
4,4'-DDT	71

	NJDEP	NJDEP	USEPA	USEPA
	Surface	Surface	Water	Water
Constituents	Water Quality	Water Quality	Quality	Quality
	Standards	Standards	Criteria	Criteria
	(Aquatic)	(Human Health)	(Freshwater)	(Human Health)
Semi-Volatile Organics (Cont'd)		`		<u> </u>
Indeno(1,2,3-cd)pyrene	-	0.0028	<u>-</u>	0.0044
Dibenz(a,h)anthracene	_	0.0028	-	0.0044
Benzo(g,h,i)perylene		-] -	-
Pesticides/PCBs				
alpha-BHC	_	0.0039	-	0.0039
beta-BHC	-	0.137	-	0.014
delta-BHC	-	-	_	_
gamma-BHC (Lindane)	0.08	0.19	0.16	0.019
Heptachlor	0.0038	0.000208	0.0038	0.00021
Aldrin	3	0.00013	1.3	0.00013
Heptachlor epoxide	0.0038	0.0001	0.0038	0.0001
Endosulfan I	0.056	0.93	0.056	110
Dieldrin	0.0019	0.000135	0.056	0.00014
4,4'-DDE	-	0.000588	-	0.00059
Endrin	0.0023	0.629	0.036	0.76
Endosulfan II	0.056	0.93	0.056	110
4,4'-DDD	-	0.00083	-	0.00083
Endosulfan sulfate	-	0.93	-	110
4,4'-DDT	0.001	0.000588	0.001	0.00059
Methoxychlor	0.03	40	0.03	100
Endrin ketone	-	-	-	-
Endrin aldehyde	ĺ -	0.76	-	0.76
alpha-Chlordane	0.0043	0.000277	0.0043	0.0021
gamma-Chlordane	0.0043	0.000277	0.0043	0.0021
Toxaphene	0.0002	0.00073	0.0002	0.00073
Aroclor-1016	0.014 *	0.000044	0.014 *	0.00017*
Aroclor-1221	0.014 *	0.000044	0.014 *	0.00017*
Aroclor-1232	0.014 *	0.000044	0.014 *	*71000.0
Aroclor-1242	0.014 *	0.000044	0.014 *	0.00017*
Aroclor-1248	0.014 *	0.000044	0.014 *	0.00017*
Aroclor-1254	0.014 *	0.000044	0.014 *	0.00017*
Aroclor-1260	0.014 *	0.000044	0.014 *	0.00017*

TABLE 3-2 (Sheet 5 of 5)

APPLICABLE CRITERIA FOR SEDIMENTS AND SURFACE WATERS

Constituents	NJDEP Guidance for Sediment Quality Evaluation
Pesticides/PCBs (Cont'd)	
Methoxychlor	-
Endrin ketone	-
Endrin aldehyde	-
alpha-Chlordane	6
gamma-Chlordane	6
Toxaphene	-
Aroclor-1016	530 *
Aroclor-1221	530 *
Aroclor-1232	530 *
Aroclor-1242	530 *
Aroclor-1248	530 *
Aroclor-1254	530 *
Aroclor-1260	530 *
Metals and Cyanide	
Aluminum	-
Antimony	-
Arsenic	33
Barium	-
Beryllium	-
Cadmium	10
Calcium	-
Chromium	110
Cobalt	-
Copper	110
Iron	-
Lead	250
Magnesium	_
Manganese	-
Mercury	2
Nickel	75
Potassium	_
Selenium	_
Silver	
Sodium	
Thallium	<u> </u>
	-
Vanadium	222
Zinc	820
Cyanide	_ l

Constituents	NJDEP Surface Water Quality Standards (Aquatic)	NJDEP Surface Water Quality Standards (Human Health)	USEPA Water Quality Criteria (Freshwater)	USEPA Water Quality Criteria (Human Health)
Metals and Cyanide				1
Aluminum	-	-	87	-
Antimony	-	12.2	-	14
Arsenic	190	0.017	150	0.018
Barium	-	2000	-	1000
Beryllium	-	-	-	-
Cadmium	1	10	2.2	•
Calcium	-	-	-	-
Chromium	180 **	160	74 **	-
Cobalt	-	-	-	-
Copper	11	-	9	1300
Iron	-	-	1000	300
Lead	2.5	5	2.5	-
Magnesium	-	•	-	-
Manganese		-	-	50
Mercury	0.012	0.14	0.77	0.05
Nickel	160	516	52	610
Potassium	-	-	-	-
Selenium	5	10	5	170
Silver	3.4	164	3.4	-
Sodium	· -	-	-	-
Thallium	-	1.7	-	1.7
Vanadium	-	-	-	-
Zinc	110	-	120	9100
Cyanide	5.2	700	5.2	700

Notes:

- = No criteria available.
- * = Criteria value corresponds to the sum of all PCBs.
- ** = Criteria value corresponds to chromium (+3).

Sediment values are provided in mg/kg [at 1 percent total organic carbon] for volatile organics, in mg/kg organic carbon for semi-volatile organics and pesticides/PCBs, and in mg/kg for metals. All surface water values are provided in ug/L.

TABLE 3-3
APPLICABLE CRITERIA FOR BUILDING INTERIOR

Constituents	NJAC 7:26D-2.2 Building Interior Surface (Floor to 6 ft.) mg/m2
Total PCBs	0.27
Antimony	30
Arsenic	0.22
Cadmium	28
Lead	2.1
Mercury	24

Constituents	NJAC 7:26D-2.2 Building Interior Air ug/m3
Mercury	0.3

TABLE 3-4 (Sheet 1 of 4)

APPLICABLE CRITERIA FOR GROUNDWATER

	USEPA	NJDEP Safe	NJDEP
Comptitue			Groundwater
Constituents	Drinking Water	Drinking Water Act Standards	1
	Regulations (MCLs)	(MCLs)	Quality Criteria
	(MCLs)	(WICLS)	(Class II)
Volatile Organics			20
Chloromethane	- !	-	30
Bromomethane	-	-	10
Vinyl Chloride	2	2	5
Chloroethane	-	-	100 **
Methylene Chloride	5	3 *	2
Acetone	_	-	700
Carbon Disulfide	-	-	100 **
1,1-Dichloroethene	7	2	2
1,1-Dichloroethane	-	50 *	70
cis-1,2-Dichloroethene	70	70 *	10
trans-1,2-Dichloroethene	100	100 *	100
Chloroform	100	-	6
1,2-Dichloroethane	5	. 2	2
2-Butanone	-	-	300
Bromochloromethane	-	-	100 **
1,1,1-Trichloroethane	200	30 *	30
Carbon Tetrachloride	5	2	2
Bromodichloromethane	100	-	1
1,2-Dichloropropane	5	5	1
cis-1,3-Dichloropropene	-	-	100 **
Trichloroethene	5	1	1
Dibromochloromethane	100	-	10
1,1,2-Trichloroethane	5	3 *	3
Benzene	5	1	1
trans-1,3-Dichloropropene	_	-	100 **
Bromoform	100	-	4 .
4-Methyl-2-Pentanone	_	_	400
2-Hexanone		-	100 **
Tetrachloroethene	5	1	1
1,1,2,2-Tetrachloroethane		1*	2
1,2-Dibromoethane	_		100 **
Toluene	1000	1000	1000
Chlorobenzene	-	50 *	4
Ethylbenzene	700	700	700
Styrene	100	100	100
Xylenes (total)	10000	1000 *	40
1,3-Dichlorobenzene	10000	600	600
1,4-Dichlorobenzene	75	75	75
1,2-Dichlorobenzene	600	600	i i
	1 600	000	600
1,2-Dibromo-3-chloropropane	70	-	100 **
1,2,4-Trichlorobenzene	70	9	9
Semi-Volatile Organics			
Phenol	-	-	4000
bis(2-Chloroethyl) ether	-	-	10
2-Chlorophenol	-	-	40
2-Methylphenol	<u> </u>		100 **

TABLE 3-4 (Sheet 2 of 4)

APPLICABLE CRITERIA FOR GROUNDWATER

	USEPA	NJDEP Safe	NJDEP
Constituents	Drinking Water	Drinking Water	Groundwater
	Regulations	Act Standards	Quality Criteria
	(MCLs)	(MCLs)	(Class II)
Semi-Volatile Organics (Cont'd)			
4-Methylphenol	-	-	100 **
N-Nitroso-di-n-propylamine	-	-	20
Hexachloroethane	-	-	10
Nitrobenzene	-	-	10
Isophorone	-	-	100
2-Nitrophenol	-	-	100 **
2,4-Dimethylphenol	-	-	100
bis(2-Chloroethoxy)methane	-	=	100 **
2,4-Dichlorophenol	_	_	20
Naphthalene	_	300 *	100 **
4-Chloroaniline	_	_	100 **
Hexachlorobutadiene	_	_	1
4-Chloro-3-methylphenol	_	_	100 **
2-Methylnaphthalene	_		100 **
Hexachlorocyclopentadiene	50	50	10
2,4,6-Trichlorophenol	50	50	20
2,4,5-Trichlorophenol	-	-	700
· · ·	-	-	
2-Chloronaphthalene	-	-	100 **
2-Nitroaniline	-	-	100 **
Dimethylphthalate	-	-	100 **
Acenaphthylene	-	-	100 **
2,6-Dinitrotoluene	-	-	100 **
3-Nitroaniline	-	-	100 **
Acenaphthene	-	=	400
2,4-Dinitrophenol	-	-	40
4-Nitrophenol	-	-	100 **
Dibenzofuran	•	-	100 **
2,4-Dinitrotoluene	-	-	10
Diethylphthalate	-	-	5000
4-Chlorophenyl-phenylether	-	-	100 **
Fluorene	-	-	300
4-Nitroaniline	-	_	100 **
4,6-Dinitro-2-methylphenol	-	-	100 **
N-Nitrosodiphenylamine	-	-	20
4-Bromophenyl-phenylether	_	_	100 **
Hexachlorobenzene	1	1	10
Pentachlorophenol	1	i	10
Phenanthrene	<u> </u>		100 **
Anthracene	_		2000
Di-n-butylphthalate	-	<u>-</u>	900
Fluoranthene	-	-	300
Pyrene	-	-	
•	-	-	200
Butylbenzylphthalate	-	-	100
3,3'-Dichlorobenzidine	-	-	60
Benzo(a)anthracene	-	-	5 **
Chrysene	-	, -	5 **
bis(2-Ethylhexyl)phthalate	-		30

TABLE 3-4 (Sheet 3 of 4)

APPLICABLE CRITERIA FOR GROUNDWATER

Constituents	USEPA Drinking Water Regulations (MCLs)	NJDEP Safe Drinking Water Act Standards (MCLs)	NJDEP Groundwater Quality Criteria (Class II)	
Semi-Volatile Organics (Cont'd)				
Di-n-octylphthalate	_	-	100	
Benzo(b)fluoranthene	_	-	5 **	
Benzo(k)fluoranthene	_	_	5 **	
Benzo(a)pyrene	0.2	0.2	5 **	
Indeno(1,2,3-cd)pyrene	<u>-</u>	-	5 **	
Dibenz(a,h)anthracene	_	-	5 **	
Benzo(g,h,i)perylene	_	_	100 **	
Pesticides/PCBs				
alpha-BHC	_	_	0.02	
beta-BHC		_	0.02	
delta-BHC	_	ِ ۔	100 **	
gamma-BHC (Lindane)	0.2	0.2	0.2	
Heptachlor	0.2	0.2	0.2	
Aldrin	0.4	. 0.4	0.4	
	0.2	0.2	0.04	
Heptachlor epoxide Endosulfan I	0.2	0.2	0.2	
Dieldrin	<u>-</u>	-		
	<u>-</u>	-	0.03	
4,4'-DDE Endrin	2	-	0.1 2	
Endrin Endosulfan II	2	2	0.4	
4,4'-DDD	-	-	1	
• · ·	-	-	0.1	
Endosulfan sulfate	-	-	0.4	
4,4'-DDT	-	-	0.1	
Methoxychlor	40	40	40	
Endrin ketone	-	-	100 **	
Endrin aldehyde	-	-	100 **	
alpha-Chlordane	2	0.5	0.5	
gamma-Chlordane	2	0.5	0.5	
Toxaphene	3	3	3	
Aroclor-1016	0.5 ***	0.5 ***	0.5 ***	
Aroclor-1221	0.5 ***	0.5 ***	0.5 ***	
Aroclor-1232	0.5 ***	0.5 ***	0.5 ***	
Aroclor-1242	0.5 ***	0.5 ***	0.5 ***	
Aroclor-1248	0.5 ***	0.5 ***	0.5 ***	
Aroclor-1254	0.5 ***	0.5 ***	0.5 ***	
Aroclor-1260	0.5 ***	0.5 ***	0.5 ***	
Metals and Cyanide				
Aluminum	-	-	200	
Antimony	0.006	6	20	
Arsenic	0.05	50	8	
Barium	2	2000	2000	
Beryllium	0.004	4	20	
Cadmium	0.005	5	4	
Calcium	-			
Chromium	0.1	100	100	
Cobalt	0.1	-	100	
Copper	1.3	1300	1000	

TABLE 3-4 (Sheet 4 of 4)

APPLICABLE CRITERIA FOR GROUNDWATER

Constituents	USEPA Drinking Water Regulations (MCLs)	NJDEP Safe Drinking Water Act Standards (MCLs)	NJDEP Groundwater Quality Criteria (Class II)	
Metals and Cyanide (Cont'd)				
Iron	-	300	300	
Lead	0.015	15	10	
Magnesium	-	-	-	
Manganese	-	50	50	
Mercury	0.002	2	2	
Nickel	0.1	-	100	
Potassium	-	-	-	
Selenium	0.05	50	50	
Silver	-	100	-	
Sodium	_	-	50000	
Thallium	0.002	2	10	
Vanadium	-	-	-	
Zinc		5000	5000	
Cyanide	0.2	•	200	
Other Constituents				
Haloacetic acids	0.06	-	-	
Chlorite	1	-	-	
Bromate	0.01	-	-	

Notes:

- = No criteria available
- * = Values correspond to NJDEP "Interim Specific Criteria".
- ** = Values correspond to NJDEP "Interim Generic Groundwater Quality Criteria" for synthetic organic chemicals.
- *** = Value corresponds to the sum of all PCBs.

All groundwater criteria provided in ug/L.

Section No.: 3
Page: 17 of 22
Revision No.: 1
Date: March 2000

NJDEP Safe Drinking Water Act Standards (NJDEP, 1996), with revisions (NJDEP, 1997). In addition, Class II (i.e., groundwater utilized as a source of drinking water) standards present in NJDEP Groundwater Quality Criteria (NJDEP, 1993) will be used for comparison to groundwater data results (see Table 3-4).

3.3 DATA QUALITY CATEGORIES

DQOs are composed of written expectations for precision, accuracy, representativeness, completeness and comparability of a data set. These aspects will be further defined in Section 3.4. The DQO process provides a logical basis for linking the QA/QC procedures to the intended use of the data, primarily through the decision maker's acceptable limits on decision error. Two descriptive data categories - screening data and definitive data - will be used for the Cornell-Dubilier Site.

Screening data are generated by rapid, less precise methods of analysis, and are deemed non-critical to project objectives. Portable instruments to be used during this field investigation to collect screening data include:

- Interface probe/water level indicator
- Dissolved oxygen meter
- pH meter
- Specific conductivity meter
- Temperature meter
- Turbidity meter
- Photoionization detector (PID)
- Flame ionization detector (FID)
- Magnetometer (configured as a vertical gradiometer)
- Ground conductivity meter
- Soil gas survey equipment
- Portable gas chromatograph (GC)

Definitive data are generated using specific analytical methods and guidelines and have satisfied known QA/QC requirements. Analytical data provided by an off-site laboratory shall be definitive data, and are deemed critical to project objectives. QA/QC elements of definitive data include determination and documentation of calibrations, detection limits, method blanks, and matrix spike

Section No.: _3
Page: _18 of _22
Revision No.: _1
Date: <u>March 2000</u>

recoveries. Additional information on analytical QC elements and their acceptance criteria are provided in Section 9.2. For further information on analytical data validation and reporting, see Section 10.0.

3.4 QA/QC CHARACTERISTICS

The overall QA/QC objective for the field investigation is to develop and implement procedures that will provide data of known and documented quality. QA/QC characteristics for data include precision, accuracy, representativeness, completeness, and comparability (PARCC). Data quality objectives for each of these parameters are determined based on the level of data required. Descriptions of these characteristics are provided below, and specific QA objectives for both screening and definitive data are presented on Table 3-5. Analytical matrices and methods are provided on the table; further information on the field investigation procedures and analytical methodologies are presented in Sections 4.0 and 6.0, respectively.

Precision is the measurement of agreement in repeated tests of the same or identical samples, under prescribed conditions. Analytical precision can be expressed in terms of Standard Deviation (SD), Relative Standard Deviation (RSD) and/or Relative Percent Difference (RPD). The precision of analytical environmental samples has two components - laboratory precision and sampling precision. Laboratory precision is determined by replicate measurements of laboratory duplicates and by analysis of reference materials. The objectives for laboratory precision are specified in the analytical methodologies and are presented on Table 3-5. The precision of the field sampling effort is determined by the analysis of field duplicate samples; see Section 9.1.5. Field duplicate analysis will be performed at a rate of five percent (i.e., one duplicate collected for every 20 samples), and acceptance criteria for these duplicates shall be an RPD of 25 percent. The precision limits provided in Table 3-1 for the screening measurements are acceptance criteria for duplicate and calibration analyses of field measurement parameters.

Accuracy is the degree of agreement of a measured sample result or average of results with an accepted reference or true value. It is the quantitative measurement of the bias of a system, and is expressed in terms of percent recovery (%R). Measurements of accuracy for the laboratory include surrogate spike, laboratory control spike, matrix spike and matrix spike duplicate samples. The laboratory must meet or exceed control limit objectives, as stated in Table 3-5 and the applicable methodologies.

300425

Section No.: 3
Page: 19 of 22
Revision No.: 1
Date: March 2000

TABLE 3-5 (Sheet 1 of 3) QA OBJECTIVES FOR FIELD INVESTIGATION DATA

<u>Parameter</u>	<u>Measurement</u>	<u>Matrix</u>	<u>Method</u>	<u>Units</u>	<u>Precision</u>	<u>Accuracy</u>	<u>PQL</u>	<u>Completeness</u> (<u>%)</u>
Water Level	Screening	Aqueous	Direct Field Measurement	feet	± 0.01 feet	N/A	N/A	90
NAPL	Screening	Aqueous	Direct Field Measurement	feet	± 0.01 feet	N/A	N/A	90
pН	Screening	Aqueous	Direct Field Measurement	Std. Units	± 0.1 units	N/A	N/A	90
Temperature	Screening	Aqueous	Direct Field Measurement	°C	± 0.1 °C	N/A	N/A	90
Specific Conductivity	Screening	Aqueous	Direct Field Measurement	umhos/cm or mS/cm	± 1% of full scale*	N/A	N/A	90
Eh	Screening	Aqueous	Direct Field Measurement	mV	± mV	N/A	N/A	90
Dissolved Oxygen	Screening	Aqueous	Direct Field Measurement	mgO ₂ /L	± 3%	N/A	N/A	90
Turbidity	Screening	Aqueous	Direct Field Measurement	NTU	± 2 NTU	N/A	N/A	90
Soil Gas Survey	Screening	Soil Gas	Direct Field GC Measurement	ug/L	± 50% RPD	75-125% R	25 ug/L	90
VOC Vapors	Screening	Soil	Direct Field Measurement (PID/FID)	ppm	± 20%	N/A	NA	N/A
TCL VOCs	Definitive	Solid	OLM04.2 (or latest revision)	ug/kg	± 25% RPD	59-172% R	10 ug/kg (low); 1200 ug/kg (medium)	90
TCL SVOCs	Definitive	Solid	OLM04.2 (or latest revision)	ug/kg	± 25% RPD	11-142% R	Compound Specific (330-830 ug/kg)	90 .

Section No.: 3
Page: 20 of 22
Revision No.: 1
Date: March 2000

TABLE 3-5 (Sheet 2 of 3)
QA OBJECTIVES FOR FIELD INVESTIGATION DATA

<u>Parameter</u>	<u>Measurement</u>	<u>Matrix</u>	<u>Method</u>	<u>Units</u>	<u>Precision</u>	<u>Accuracy</u>	<u>POL</u>	Completeness (%)
TCL Pesticides/PCBs	Definitive	Solid	OLM04.2 (or latest revision)	ug/kg	± 25% RPD	23-139%R	Compound Specific (1.7-170 ug/kg)	90
PCB Congeners	Definitive	Solid	8082 (SW846)	ug/kg	± 25% RPD	Lab Determined	Congener Specific (0.16-0.8 ug/kg)	90
TAL Metals	Definitive	Solid	ILM04.1 (or latest revision)	mg/kg	± 20% RPD	75-125%R	Analyte Specific (0.04-1000 mg/kg)	90
Cyanide	Definitive	Solid	ILM04.1 (or latest revision)	mg/kg	± 20% RPD	75-125%R	10 mg/kg	90
Total Organic Carbon	Definitive	Solid	L. Kahn (7/88)	mg/kg	± 25% RPD	NA	100 mg/kg	90 .
Grain Size	Definitive	Solid	ASTM D422	%	± 25% RPD	NA	NA	90
Low Concentration VOCs	Definitive	Aqueous	OLC02.1 (or latest revision)	ug/L	± 25% RPD	60-140%R	Compound Specific (1-5 ug/L)	90
Low Concentration SVOCs	Definitive	Aqueous	OLC02.1 (or latest revision)	ug/L	± 25% RPD	10-120%R	Compound Specific (5-20 ug/L)	90
PCB Congeners	Definitive	Aqueous	8082 (SW846)	ug/L	± 25% RPD	Lab Determined	Congener Specific (0.005-0.025 ug/L)	90
Low Concentration Pesticides/PCBs	Definitive	Aqueous	OLC02.1 (or latest revision)	ug/L	± 25% RPD	30-150%R	Compound Specific (0.1-1.0 ug/L)	90
TAL Metals	Definitive	Aqueous	ILM04.1 (or latest revision)	ug/L	± 25% RPD	75-125%R	Analyte Specific (0.2-5000 ug/L)	90

300426

Section No.: 3 Page: 21 of 22 Revision No.: 1

Date: March 2000

TABLE 3-5 (Sheet 3 of 3) OA OBJECTIVES FOR FIELD INVESTIGATION DATA

<u>Parameter</u>	<u>Measurement</u>	<u>Matrix</u>	<u>Method</u>	<u>Units</u>	Precision	<u>Accuracy</u>	<u>POL</u>	Completeness (%)
Cyanide	Definitive	Aqueous	ILM04.1 (or latest revision)	ug/L	± 20% RPD	75-125%R	10 ug/l	90
TOC	Definitive	Aqueous	MCAWW 415.1	mg/L	± 25% RPD	NA	1 mg/L	90
DOC	Definitive	Aqueous	MCAWW 415.1	mg/L	± 25% RPD	NA	1 mg/L	90
TSS	Definitive	Aqueous	MCAWW 160.2	mg/L	± 25% RPD	NA	4 mg/L	90
TDS	Definitive	Aqueous	MCAWW 160.1	mg/L	± 25% RPD	NA	10 mg/L	90
Ammonia	Definitive	Aqueous	MCAWW 350.3	mg/L	± 25% RPD	NA	0.1 mg/L	90
Nitrate-Nitrite	Definitive	Aqueous	MCAWW 353.2	mg/L	± 25% RPD	NA	0.01 mg/L	90
Total Phosphorus	Definitive	Aqueous	MCAWW 365.2	mg/L	± 25% RPD	NA	0.01 mg/L	90
Hardness	Definitive	Aqueous	MCAWW 200.7	mg/L	± 25% RPD	NA	10 mg/L	90
Chloride	Definitive	Aqueous	MCAWW 325.3	mg/L	± 25% RPD	NA	1 mg/L	90
Chlorite	Definitive	Aqueous	300.1	ug/L	± 25% RPD	75-125% R	Lab Determined	90
Bromate	Definitive	Aqueous	300.1	ug/L	± 25% RPD	75-125% R	Lab Determined	90
Haloacetic Acids	Definitive	Aqueous	552.2	ug/L	± 25% RPD	70-130% R	Compound Specific 0.2 - 1.5 ug/L	90

Notes:

Abbreviations include:

%R = Percent Recovery

N/A = Not Applicable
NTU = Nephelometric Turbidity Units

RPD = Relative Percent Difference

TAL = Target Analyte List VOCs = Volatile Organic Compounds

PQL = Practical Quantitation
NAPL = Non-Aqueous Phase Liquid
PCB = Polychlorinated Biphenyl
SVOCs = Volatile Organic Compounds

TCL = Target Compound List

^{*} Precision dependent on meter and scale.

Page: 22 of 22
Revision No.: 1

Date: March 2000

Representativeness is the degree to which the results of the analyses accurately and precisely represent a characteristic of a population, a process condition, or an environmental condition. In this case, representativeness is the degree to which the data reflect the contaminants present and their concentration magnitudes in the sampled site areas. Representativeness of data will be ensured through the selection of sampling locations and implementation of approved sampling procedures. Results from environmental field duplicate sample analyses can be used to assess representativeness, in addition to precision.

Completeness is defined as the percentage of samples that meet or exceed all the criteria objective levels for accuracy, precision and detection limits within a defined time period or event. It is the measure of the number of data "points" which are judged to be valid, usable results. The objectives for completeness for this field investigation is 90 percent, and will be calculated by dividing the number of usable data results (i.e., all results not considered to be "rejected" and all samples able to be analyzed) by the number of possible data results (i.e., the total number of field samples collected), and then multiplying by 100 percent.

Comparability is the degree of confidence with which results form two or more data sets, or two or more laboratories, may be compared. To achieve comparability, standard environmental methodologies will be employed in the field and in the laboratory. See Table 3-5 and Section 6.0 for analysis methods and detection limits for this field investigation.

3.5 IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES

The QA objectives presented in Table 3-5 represent the data quality necessary to meet the project's technical goals. The QA/QC efforts discussed in this QAPP focus on controlling measurement error, and ultimately providing a database for estimating the uncertainty in the measurement data for the project. QA objectives will be evaluated throughout the field investigation effort to see if the results for the project meet the stated objectives. If these objectives are not being met, the precision and/or accuracy of the sampling data will be decreased, and corrective actions shall be taken, as documented in Section 13.0.

Section No.: 4
Page: 1 of 12
Revision No.: 1
Date: March 2000

4.0 FIELD INVESTIGATION ACTIVITIES

This section provides an overview of the Reconnaissance Phase and Phase I Investigation activities and sampling operations by matrix and type of procedures, and includes the following:

Mobilization/Demobilization

Site Survey

Geophysical Survey

Soil Gas Survey

Dye Testing

Building Interior Sampling (Floor Dust)

Test Pit Investigation

Wetlands and Habitat Delineation

Off-Site Residential/Commercial Property Soil Sampling

On-Site Surface Soil Sampling

On-Site Subsurface Soil Sampling

Soil Sample Field Screening

Hydropunch Sampling

Monitoring Well Installation and Development

Drainage System Sampling

Ecological Resources Reconnaissance

Water Level Measurements

Groundwater Sampling

Decontamination

4.1 SAMPLING PROGRAM PROCEDURES

The sampling program to be conducted at the Cornell-Dubilier Site will be conducted in accordance with established technical guidelines, methods, policies and Standard Operating Procedures (SOPs). The subsections below present an overview of the sampling program procedures; a more detailed discussion of the sampling program is presented in Section 3.3 of the FSP (Part A of the Field Operations Plan [FOP]). A schedule for the implementation of the field sampling program is provided in Section 4.0 of the Work Plan.

Section No.: <u>4</u> Page: <u>2</u> of <u>12</u>

Revision No.: 1

Date: March 2000

4.1.1 Mobilization and Demobilization

The mobilization effort will consist of logistical planning, identification and staking of sampling locations, equipment mobilization to the Site, and field personnel orientation. The orientation meeting will familiarize the sampling team with a brief history of the Site, health and safety requirements, and field investigation procedures.

Equipment and personnel will be demobilized at the completion of each phase of field activities, as appropriate. Demobilization will consist of site area clean-up, staging and inventory of investigation-derived wastes, decontamination and demobilization of field equipment, and organization of investigation records.

4.1.2 Site Survey

Sampling locations (i.e., monitoring wells, soil borings, etc.) will be surveyed for horizontal location (nearest 0.1 foot), ground elevation (nearest 0.1 foot), and measuring point elevation (nearest 0.01 foot) by a qualified licensed surveying subcontractor. The survey will include the elevation of the top of the monitoring well casing, with the well cap removed, for determination of water table elevations. In addition, the boundaries of the off-site residential and commercial properties to be sampled will be surveyed, in preparation for determining applicable surface soil sampling grids.

4.1.3 Geophysical Survey

A geophysical investigation will be performed to delineate areas of possible subsurface disposal in the southern portion of the Site. Approximately 12 acres will be divided into sub-plots and surveyed using magnetometry and frequency-domain electromagnetic induction (through the use of a ground conductivity meter). In addition, the geophysical investigation will also be used to assist in locating any on-site production wells.

4.1.4 Soil Gas Survey

Initial field screening will consist of a soil gas survey to be performed around the Site, for the delineation of possible subsurface disposal areas and potential source areas. A 100 foot by 100 foot rectilinear grid will be established on a majority of the Site, with soil gas samples collected at the grid nodes. Additional soil gas samples will be collected at 25 foot by 25 foot grid nodes in the

Section No.: 4
Page: 3 of 12
Revision No.: 1
Date: March 2000

vicinity of the test pit locations, at 50 foot by 50 foot grid nodes around the east-northeast Site buildings (where large pits were present in the basement, and a sheen was noticed on the standing water within the pits), and at any other additional areas determined during the field investigation (e.g., potential discharge locations determined from dye testing, elevated levels present during real-time sampling, etc.). Actual sampling locations will be adjusted in the field to ensure sampling in vegetated areas between on-site buildings. An estimated total of 225 samples is proposed at this time. Soil gas sampling will involve drilling a hole approximately 4 to 5 feet deep and collecting a gas sample through a tube sealed into the hole. A field gas chromatograph (GC) would determine screening concentrations of the following compounds: benzene; toluene, ethylene; xylenes; carbon tetrachloride; chloroform; 1,1-dichloroethene; cis-1,2-dichloroethene; trans-1,2-dichloroethene; 1,1-dichloroethane; methylene chloride; trichloroethene; tetrachloroethene; 1,1,1-trichloroethane; and 1,1,2-trichloroethane. The soil gas survey will be performed by a subcontractor, under the supervision of the Foster Wheeler Environmental Site Geologist or his designee. The subcontractor shall be responsible for all services, equipment and material required to perform soil gas collection and analyses, including maintenance and quality control.

4.1.5 Dye Testing

The locations of on-site catch basins, sumps, drains, manholes, outfalls, etc. will be determined during the Reconnaissance Phase. From these locations, potential discharge pathways and endpoints will be approximated. Dye testing will be performed, as necessary, to determine actual discharge locations. For planning purposes, the performance of five dye tests have been estimated.

4.1.6 Building Interior Sampling [Floor Dust]

Floor dust sampling will be performed in the 24 on-site buildings, to determine levels of indoor contamination. One (1) sample will be collected every 10,000 square feet or portion thereof, for at least one (1) sample per building. Particulate matter will be withdrawn from the carpeted and/or bare floor areas by a flowing air stream (vacuum) passing through a sampling nozzle. Particles approximately 5 micrometers (um) in diameter and larger will be collected for laboratory analysis of Target Compound List (TCL) PCBs and Target Analyte List (TAL) metals.

Section No.: 4
Page: 4 of 12
Revision No.: 1

Date: March 2000

4.1.7 Test Pit Investigation

A test pit program will be performed to determine the nature and location of buried wastes in the potential disposal areas (i.e., the central portion of the Site). Approximately 10 test pits will be excavated to a maximum depth of 10 feet bgs, and are estimated at 10 feet in length. Final depths and lengths will be determined by the Site Geologist during the investigation.

Collection of soil samples from the test pits may be performed as necessary and appropriate (e.g., if stained soil is present). For planning purposes, 10 samples have been estimated, for analysis of TCL volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), TCL pesticides/PCBs, and TAL metals and cyanide.

If groundwater is encountered during excavation of the test pits, a water sample shall be collected if a sheen or odors are detected. For planning purposes, 10 samples have been estimated for analysis of low concentration VOCs, low concentration SVOCs, low concentration pesticides/PCBs, and TAL metals and cyanide.

4.1.8 Wetlands and Habitat Delineation

A delineation of wetland areas and vegetation habitats within the property boundaries of the Site will be conducted pursuant to the U.S. Army Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987). In addition, approximate wetland boundaries for areas adjacent to Bound Brook downstream of the Site will be determined in an in-office review of information and then field verified. Visual assessments of the vegetation and hydrology will be conducted, and on-site, these indicators will be characterized and sampled as necessary.

4.1.9 Off-Site Residential/Commercial Property Soil Sampling

Surface (0 to 2 inch depth) and shallow subsurface (16 to 18 inch depth) soil samples will be collected from a total of 36 residential and commercial properties located in the vicinity of the Site. Sampling grids will be established to facilitate collection of the soil samples for PCB analysis (see Section 4.1.2), and these sampling grids will be submitted to USEPA for approval prior to sample collection.

Section No.: 4
Page: 5 of 12
Revision No.: 1
Date: March 2000

A total of 659 surface soil samples will be collected using stainless steel scoops/spoons, and placed directly into the sample container. A total of 190 subsurface soil samples will be collected on the properties by hand auger. The subsurface soil will be placed in stainless steel bowls for homogenization prior to sample collection. Samples shall be labeled and iced immediately after collection, and all surface and subsurface residential/commercial samples will be analyzed only for TCL PCBs.

Following evaluation of the results obtained during the Reconnaissance Phase and from previous investigations, additional residential/commercial property areas may be sampled during the Phase II Investigation.

4.1.10 On-Site Surface Soil Sampling

Twenty-one (21) surface soil samples will be collected from 0 to 6 inches below ground surface [bgs] (6 to 12 inches bgs for VOCs) from each monitoring well boring location (11) and from various locations on-site and off-site (10) during the Phase I Investigation. Additional surface soil samples may be collected during the Phase II Investigation, depending on the Phase I sampling results. Surface soil sampling will be conducted with hand tools, and will be logged by the Site Geologist or his designee. A small sample coring device (EnCore® Sampler) will be used to collect the VOC sample. The remainder of the soil will be collected using stainless steel scoops and placed in stainless steel bowls for homogenization prior to sample collection. Samples shall be labeled and placed on ice immediately after collection. All surface soils will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides and PCBs, TAL metals and cyanide, total organic carbon (TOC) and grain size. In addition, three surface soil samples (SS02, SS03 and MW09) will be analyzed for PCB congeners.

4.1.11 On-Site Subsurface Soil Sampling

Subsurface soil sampling will be conducted at 11 locations, corresponding to the installation of the Phase I Investigation monitoring wells. Soil samples will be obtained during drilling operations at 2-foot intervals to bedrock. However, soil samples will be submitted for laboratory analysis only from the following depth intervals: between 0 feet and the top of weathered bedrock (depth chosen based on field observations and most elevated field screening result); at the top of weathered bedrock; between the top of weathered bedrock and competent bedrock (depth chosen based on field observations and most elevated field screening result); and at the top of competent bedrock.

Section No.: 4
Page: 6 of 12
Revision No.: 1
Date: March 2000

Additional samples may be sent from a location if field conditions require (i.e., there are 2 layers of stained soil with relatively elevated field screening results within the overburden interval). The soil samples for TCL VOCs will be collected from the middle of the sample tube using a small sample coring device (EnCore® Sampler). The remaining soil will be homogenized in a stainless steel bowl prior to sample collection. Samples shall be labeled and placed on ice immediately after collection, for analysis of TCL VOCs, TCL SVOCs, TCL pesticides and PCBs, TAL metals and cyanide, TOC, and grain size. In addition, the soil sample collected in the overburden interval (unless visual and/or instrument screening indicates a significantly more contaminated sample from a deeper soil zone) in borings MW04, MW06 and MW09 will be analyzed for PCB congeners.

Subsurface soil samples will also be collected in and around the 24 on-site buildings, especially near catch basins, drains, pits, etc. The number of locations will depend on information obtained during the Reconnaissance Phase; however, at this time, it is estimated that three borings will be drilled in/around each building. Soil samples will be collected at two sample intervals: 0 to 6 inches beneath the concrete or other surface covering (6 to 12 inches for VOCs) and 12 to 24 inches below the covering (18 to 24 inches for VOCs), for an estimated total of 144 soil samples. The deeper interval soils will be collected by hand auger, with direct collection of the TCL VOC fraction. Analyses include TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals and cyanide.

Based on the results obtained during the Reconnaissance Phase and the Phase I Investigation, additional subsurface soil locations may be sampled during the Phase II Investigation.

4.1.12 Soil Sample Field Screening

Soil samples will be field screened using a flame ionization detector (FID) and a photoionization detector (PID). The field screening results for the intervals between 0 feet and the water table and between the water table and bedrock will determine the selection of monitoring well boring soil samples for chemical analysis.

4.1.13 Hydropunch® Sampling

Hydropunch® groundwater sampling will be conducted at the 11 monitoring well borings during installation. These samples will provide groundwater results at varying depths to determine the vertical profile of contaminants in the aquifer and to identify possible contaminant migration pathways. Hydropunch® groundwater samples will be collected if groundwater is encountered in the

Section No.: 4
Page: 7 of 12
Revision No.: 1
Date: March 2000

unconsolidated overburden and/or weathered bedrock, and will be analyzed for low concentration VOCs and low concentration PCBs. Based on the site geology, it is estimated that only one sample per well boring will be collected, for a total of 11 Hydropunch® groundwater samples.

4.1.14 Monitoring Well Installation and Development

Eleven (11) monitoring wells (MW01 through MW11) will be installed during the Phase I Investigation field program. As necessary, based on the data results, additional monitoring wells will be installed at the Site during the Phase II Investigation. Unless otherwise necessary due to depth, wells will be constructed as up to 25 feet of open hole in bedrock. The monitoring wells will be developed by pumping and surging, until there is less than 10 percent variance between successive measurements of temperature, pH, turbidity, and specific conductivity, and/or turbidity is less than 5 NTUs. Development will be continued for a minimum of two hours, but for no longer than eight hours without permission from the USEPA. In addition, a minimum volume of triple the amount of water introduced into the hole shall be removed.

4.1.15 <u>Drainage System Sampling</u>

If the presence of standing water and/or sediment is noted within the on-site drains, catch basins, manholes, etc. during the investigation, samples of the standing water and sediment will be obtained. If standing water is not present, only samples of the sediment (if also present) will be obtained. Water samples will be collected by direct fill (if possible), while shovels, trowels or remote sampling devices (depending on depth) will be used to collect the sediment sample. An estimated five locations will be sampled, for planning purposes. The surface water samples will be analyzed for low concentration VOCs, low concentration SVOCs, low concentration pesticides/PCBs, and TAL metals and cyanide. Sediment samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticide/PCBs, and TAL metals and cyanide.

4.1.16 <u>Ecological Resources Reconnaissance</u>

An ecological resources reconnaissance of the Site will be performed in support of the ecological setting characterization required for the risk assessment. This reconnaissance will consist of qualitative descriptions of vegetation cover types, observations of wildlife activities, and observations of areas of stained soils and/or stressed vegetation (if present).

The Ecological Resources Reconnaissance will also consist of a wetlands investigation. Wetlands

Section No.: 4
Page: 8 of 12
Revision No.: 1
Date: March 2000

on or adjacent to the Cornell-Dubilier Site will be delineated, during the Reconnaissance Phase, using the 1989 Federal Intergency Manual. Wetlands within the Bound Brook floodplain will be delineated during the Phase II Investigation within contaminated areas. Section 3.3.8 of the FSP (Procedure #6A) Specifies the procedures for conducting the wetland delineation.

4.1.17 Water Level Measurements

Static water level measurements will be taken in all installed monitoring wells prior to groundwater sampling. Additional water level measurements may be taken at the discretion of the FOL and/or Site Geologist throughout the field activities. In addition, measurements of water levels in selected monitoring wells will be acquired during the aquifer testing to be performed during the Phase II Investigation. A water level indicator will primarily be used to collect measurements; however, an interface probe will also be periodically used to check for the presence of any non-aqueous product. Readings obtained for the meters shall be at increments of 0.01 feet, and all measurements will be recorded in a field logbook or on applicable field investigation sheets (see Section 5.3).

4.1.18 Groundwater Sampling

Static water level measurements will be taken in the installed monitoring wells prior to each round of groundwater sampling. Groundwater samples will be collected from these monitoring wells, utilizing low-flow sampling procedures (see Section 3.3.22 of the FSP). Groundwater sampling will commence at least two weeks after well development.

One round of groundwater samples will be collected from the 11 installed monitoring wells during the Phase I Investigation. Additional groundwater sampling rounds will be performed during the Phase II Investigation. Measurement of field parameters (e.g., pH, temperature, conductivity, Eh, dissolved oxygen, and turbidity) will be performed on the purge water and on the sample water. Samples will be obtained directly from the end of the pump tubing for low-flow procedures. All sample bottles will be filled slowly and gently to avoid turbulence, with samples for VOCs always collected first. Samples shall be preserved and labeled according to applicable procedures (see Sections 5.0 and 6.0), and then placed on ice immediately after collection. For VOC samples, the amount of preservative needed shall be pre-determined in a separate VOA vial first, then this amount of preservative will be added to the VOC sample vials prior to filling. Groundwater samples will be sent to the laboratory for analysis of low concentration VOCs, low concentration SVOCs, low concentration pesticides/PCBs, TAL metals and cyanide, haloacetic acids, and water quality parameters (includes total organic carbon, dissolved organic carbon, total suspended solids, total

Section No.: <u>4</u> Page: <u>9</u> of <u>12</u>

Revision No.: 1
Date: March 2000

dissolved solids, ammonia, nitrate-nitrite, total phosphorous, hardness, chloride, chlorite, and bromate). Samples from wells MW04, MW06 and MW09 will also be analyzed for PCB congeners.

4.2 DECONTAMINATION PROCEDURES

All non-disposable equipment involved in field sampling activities will be decontaminated prior to and subsequent to sampling. Equipment leaving the Site will also be decontaminated.

All drilling equipment will be steam cleaned prior to use. Well screens and riser pipe will also be steamed cleaned to remove any cutting oils and staged on clean plastic sheeting prior to installation. Pressurized steam will be used to remove all visible excess material from augers, rods, drill bits, the back of the drill rig, and other parts of the rig which contact augers, rods, and split-spoons. Steam cleaning will be conducted on a decontamination pad, which will be constructed on-site for the field investigation.

Field instrumentation (such as interface probes, water quality meters, etc.) will be decontaminated between sample locations by rinsing with deionized water. If visible contamination still exists on the equipment after the rinse, an Alconox detergent scrub will be added, and the probe thoroughly rinsed again.

Decontamination of the floor dust sampling apparatus will consist of the following two steps:

- 1. After removal of the sample catch bottle, open the flow control valve to its maximum setting, tip the sampler back (so that the nozzle is at least 5 cm off the floor), and switch the vacuum on. Place a rubber glove-covered hand over the bottom of the cyclone, and alternate opening and closing the cyclone for 10 seconds to free any loose material adhering the walls.
- 2. Move the sampling apparatus to a well-ventilated area free of dust. Remove the cyclone and elbow at the top of the nozzle tubing. Using a 50 cm long by 3 cm diameter brush, clean the nozzle and all related items up to and including the cyclone and catch bottle with methanol. Completely air-dry the apparatus prior to re-use.

Decontamination of non-disposable sampling equipment used to collect samples for chemical analyses (i.e., scoops, trowels, bowls, etc.) will be conducted as described below:

Section No.: 4
Page: 10 of 12
Revision No.: 1
Date: March 2000

- 1. Alconox detergent and potable water scrub
- 2. Potable water rinse
- 3. Rinse with 10 percent nitric acid (ultra pure grade) when sampling for inorganics. Carbon steel split-spoons will be rinsed with a 1 percent nitric acid solution to avoid stripping of metals.
- 4. Potable water rinse
- 5. Rinse with methanol followed by a hexane rinse (solvents are pesticide grade or better) for equipment involved in the sampling of organics.
- 6. Air dry
- 7. Deionized water rinse (volume at least five times amount of solvents used in solvent rinse step above)
- 8. Air dry
- 9. Wrap or cover exposed ends of equipment with aluminum foil for transport and handling

The following decontamination procedures will be performed for the low flow purge and sampling procedures as specified by the current version of the USEPA Region II Low Stress Groundwater Sampling Procedure (provided as Attachment D to the FSP, Part A of the FOP).

Non-disposable sampling equipment, including the pump, support cable and electrical wires in contact with the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). For pumps, it is strongly recommended that non-disposable sampling equipment, including the pump, support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon"). USEPA's field experience indicates that the life of pumps may be extended by removing entrained grit. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see below).

Section No.: <u>4</u>
Page: <u>11</u> of <u>12</u>
Revision No.: <u>1</u>
Date: March 2000

Daily Decon

- 1. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- 2. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.
- 3. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- 4. Disassemble pump.
- 5. Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.
- 6. Rinse pump parts with potable water.
- 7. Rinse the pump parts with distilled/deionized water.
- 8. Place impeller assembly in a large glass beaker and rinse with 1 percent nitric acid (HNO₃).
- 9. Rinse impeller assembly with potable water.
- 10. Place impeller assembly in a large glass beaker and rinse with isopropanol.
- 11. Rinse impeller assembly with distilled/deionized water.

Between-Well Decon

- 1. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- 2. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate

Section No.: <u>4</u>
Page: <u>12</u> of <u>12</u>
Revision No.: <u>1</u>
Date: <u>March 2000</u>

detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

- 3. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
- 4. Final Rinse: Operate pump in a deep basin containing 1 to 2 gallons of distilled/deionized water, as final rinse.

Decontamination of sampling equipment will be kept to a minimum in the field, and wherever possible, dedicated disposable sampling equipment will be used. Decontamination fluids and drill cuttings will be stored in US Department of Transportation (DOT)-approved 55-gallon drums or in an on-site storage tank (liquids only) until proper disposal. Personnel directly involved in equipment decontamination will wear protective clothing, as stated in the EHS Plan (Part D of the FOP).

Section No.: 5
Page: 1 of 17
Revision No.: 1
Date: March 2000

5.0 SAMPLE CUSTODY AND DOCUMENTATION

Identification and documentation of samples are important in maintaining data quality. Strict custody procedures are necessary to ensure the integrity of the environmental samples. The subsections below address sample identification, packaging, shipping, and documentation. Procedures followed during the field investigation will be in accordance with Foster Wheeler Environmental's RAC II Program Delivery of Analytical Services Plan (Foster Wheeler Environmental, 1998) and other established guidelines and procedures. However, these guidelines/procedures do not take precedence over site-specific requirements for sample custody and documentation.

5.1 SAMPLE IDENTIFICATION SYSTEM

The method of identification of a sample depends on the type of measurement or analysis performed. When field screening measurements (e.g., pH, turbidity) are made, data are recorded directly in logbooks or on field investigation forms (see Section 5.3). Identifying information such as project name, station number, station location, date and time, name of sampler, field observations, remarks, etc. shall be recorded.

Each sample collected for on-site field GC analysis or for off-site laboratory analysis during the field investigation will be specifically designated by Foster Wheeler Environmental for unique identification. Sample locations will be designated first by a site identifier code ("CDE" for the Cornell-Dubilier Electronics Superfund Site). A letter code (see below) will follow, along with the name and/or number that depicts the specific location. Soil samples will be numbered by the depth in feet (or inches for surface soil and building boring soil samples only) at the top of the sample (e.g., the sample collected at 2 to 4 feet would be identified as "02"). Sampling events or rounds for the aqueous samples will be numbered in sequence beginning with "01". Field and trip blanks will include the letter code corresponding to the appropriate type of equipment and/or portion of the field investigation for which the blank sample was collected.

Location letter code segments for the field investigation are as follows:

- SG Soil Gas Survey Sample
- TP Test Pit Soil Sample
- SS Surface Soil Sample
- BSB Building Soil Boring Sample
- MW Monitoring Well Boring Sample

Section No.: 5
Page: 2 of 17
Revision No.: 1
Date: March 2000

MWG Monitoring Well Boring Hydropunch® Groundwater Sample

• DSW Drainage System Standing Water Sample

• DSS Drainage System Sediment Sample

BAI Building Interior [Air] Sample

• BFD Building Interior [Floor Dust] Sample

• GW Groundwater Sample

• FB Field Blank Sample

• TB Trip Blank Sample

• DWB Drilling Water Blank Sample

• DI Deionized Water Blank Sample

For example, a surface soil sample collected from location SS01 would be CDE-SS01-00. CDE-MWB07-04 would denote the 4- to 6-foot soil sample from boring location MW07. A sample collected from MW02 during the first round of groundwater sampling would be CDE-GW02-01, while one collected during the second groundwater sampling round would be CDE-GW02-02. CDE-BFD03-04 would indicate the floor dust sample collected from the fourth location in building 3. The first field blank sample collected for the monitoring well boring installation portion of the project would be CDE-MWFB-01, the second CDE-MWFB-02, etc.

All location and identification information for the samples shall be recorded on sample logsheets (see Section 5.3.1), in the field sampling logbook (see Section 5.3.2), and on the appropriate chain of custody record form for shipment (see Section 5.2.1). In addition, sampling location information may be entered into a computerized database during the field investigation (if possible).

5.2 SAMPLE CUSTODY, PACKAGING AND SHIPPING

Sample custody must be strictly maintained and carefully documented each time the sample material is collected, transported, received, prepared, and analyzed. Custody procedures are necessary to ensure the integrity of the samples, and samples collected during the field investigation must be traceable from the time the samples are collected until they are disposed of and/or stored, and their derived data are used in the final report. Sample custody is defined as (1) being in the sampler's possession; (2) being in the sampler's view, after being in the sampler's possession; (3) being locked in a secured container, after being in the sampler's possession; and (4) being placed in a designated secure area. Section 5.2.1 documents the on-site packaging and shipment procedures for sample custody in the field. The analytical laboratories will maintain custody after arrival of the samples through internal logging procedures, as indicated in Section 5.2.2.

Section No.: 5
Page: 3 of 17
Revision No.: 1
Date: March 2000

5.2.1 Field Custody, Packaging and Shipping Procedures

Field custody procedures shall be implemented for each sample collected. The field sampler shall be responsible for the care and custody of the samples until they are properly transferred or dispatched. To assure the integrity of the samples, the samples are to be maintained in a designated, secure area and/or be custody sealed in the appropriate containers prior to shipment.

Each environmental sample will be properly identified and individually labeled. Labels will be filled out in indelible ink with at least the following information: Foster Wheeler Environmental sample identification (see Section 5.1), CLP sample identification (for RAS laboratories) or laboratory identification (if known, for non-RAS laboratories), type and matrix of sample, date and time of sample acquisition, name of sampler, analysis required, and preservation (as necessary). The sample label will be securely attached to the sample container.

Environmental samples being analyzed by off-site laboratories will be properly packaged and shipped for analysis. Following labeling, the sample bottles shall be sealed with custody seals, and enclosed in clear sealable plastic bags (e.g., ziploc bags), through which the identifying label is visible. EnCore® Samplers will not be directly labeled or sealed with custody seals. The core samplers will be placed inside the manufacturer's clear sealable bag, to which a label will be affixed, and then custody seals shall be placed over the top of the closed bag.

For all samples, the sealed bags shall then be placed in a metal or hard plastic cooler that has been lined first with a large plastic bag and second with a layer of inert cushioning absorbent material, such as vermiculite. Samples are to be packed with sufficient wet ice (enclosed in double-bagged sealable plastic bags) to cool the samples to 4°C (as applicable). Additionally, each iced cooler will be packed with a cooler temperature blank (see Section 9.1.5). Lastly, the cooler should be filled with adequate cushioning material to minimize the possibility of container breakage. Any modifications to the previous procedures due to direct collection of non-RAS laboratory samples by a courier service will be documented (see Section 13.0).

A completed chain of custody form must be included with all sample shipments. Samples for a CLP RAS laboratory shall be shipped with a USEPA CLP Traffic Report/Chain of Custody form (see Figure 5-1). Figure 5-2 presents a typical chain of custody form for Foster Wheeler Environmental which may be used for non-RAS sample shipments; a laboratory-provided chain of custody may also be utilized as appropriate.

Section No.: 5
Page: 4 of 17
Revision No.: 1
Date: March 2000

FIGURE 5-1 CONTRACT LABORATORY PROGRAM CHAIN OF CUSTODY FORM (TYPICAL)

Account Code 2. Region No. Sampler (Name) Anthii Number Anthii Number Care								ТТ		ПП	T	T -]		T	3	
Account Cade 2. Region No. (Sampling Co. 4. Oute Shipped Carrier Case No.		aservative nter in lumn D)	HCI HNO3	NaHSO4 H2SO4	Other (Specify in Column D)	preserved						oer(s)		nature)	nature)		SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS -SEE REVERSE FOR PURPOSE CODE DEPARTIONS
Account Code 2. Region No. Sampling Co. 4. Date Shipped Carrier Lateratory Program Sampler (Name) Altrill Number Sampler (Sampler (Name) Sampler (Name) Sampler (Name) Sampler (Name) Additional Sampler (Sampler (Name) Sampler (- 23		, ω - 3	ž	Sampler Initials					eal Numb		by: <i>(Sig</i> i	by: (Sig	و	ANDARO E DEFINIT
Account Code 2. Region No Sampler Manne) Airbill Number For Organic CLP Analysis Sampler Signature Sampler Signatu		₹	Water	# C =	h only)	nn A)	onding organic le No.					Custody S	}	Received	Received	? Y/N/no	TIONAL SI
Account Code 2. Region No. Sampling Co. 4. Date Shipped Carrier Cl.P. Analysis Sine Spill ID Sampler (Name) Analysis Sine Spill ID Sampler (Name) Sine Spill ID Sampler (Name) Sampler (Name	5	atrix Inter Column	Surface	Leachar Field O	Waste (High o	in Colu	Correst CLP In Samp					Chain of		Time	Time	seal intact	FOR ADDI
Account Code 2. Region No. Sampling Co. Anthii Number	8	9. E. E. E.		ا در عبر در	, é, e	ó	Day/ Time tple ction							Date /	Date /	custody s	REVERSE
Account Code 2. Region No. Sampling Co. Anthii Number	ord						Mo/C Year/ Sarr Colle							(6)	(e)	larks Is	SEE
Account Code 2. Region No. Sampling Co. 3. Purpose* Enty Adien 4. Date / Time 6. Med 6. Date / Time 8. Chall 8. Chall 9. Page 8. Sample(s) to be Used for Laboratory OC CHAIL 8. Chall 9. Date / Time 9. Received by: (Signature) 9. Signature) 9. Date / Time 9. Received for Laboratory by: (Signature) 9. Date / Time 9. Received for Laboratory by: (Signature) 9. Date / Time 9. Received for Laboratory by: (Signature) 9. Date / Time 9. Received for Laboratory by:	y Rec						£ 5 b					natures		(Signatu	(Signatu	Rem	- 2
Account Code 2. Region No. Sampling Co. 3. Purpose* Enty Adien 4. Date / Time 6. Med 6. Date / Time 8. Chall 8. Chall 9. Page 8. Sample(s) to be Used for Laboratory OC CHAIL 8. Chall 9. Date / Time 9. Received by: (Signature) 9. Signature) 9. Date / Time 9. Received for Laboratory by: (Signature) 9. Date / Time 9. Received for Laboratory by: (Signature) 9. Date / Time 9. Received for Laboratory by: (Signature) 9. Date / Time 9. Received for Laboratory by:	CCLP A						Statio Statio Locatid					npler Sign	ECORD	shed by:	shed by:	e / Time	EPA Form 9110-2
Account Code 2. Region No. Sampling Co. 3. Purpose* EntrAction 4. Date / Time 6. Date / Time 7. Date / Time 7. Date / Time 8. Date / Ti	in of C	d Carrie				. !				\Box	-	ional Sar	STODY P	Relinqu	Relinqu	Dat	EPA
Account Code Sampler (Name) Samplier (Name)	S Char	te Shippe	Number	ip To		ż	ecific mber bers					Addii	N OF CU				98410
Account Code Sampler Signature Sampler Signature		4. Da	Airbil	5. S	F -		F gional Sp cking Nu Tag Num					8	CHAI	nature)	nature)	ratory by:	9
Signature) Account Code Sampler Signat Sampler (Name Sampler Signat Sampler Signat Sampler Signat Sampler Signat Sampler (Name Sampler Signat Sampler Signat Sampler Signat Sampler (Name Sampler Signat Sampler Si	*	39.			2 g 🗍 –	Ш						boratory (by: (Sig	by: (Sig	for Labo	SS Copy
Signature) Account Code Sampler Signat Sample Signature) Signature) Account Code Sampler Signat Sample Signature) Sample Signature) Signature) Contract Laboratory Programming Sample Signature Signature) Signature) Contract Laboratory Programming Sample Signature Signature) Signature) Contract Laboratory Programming Sample Signature Signature) Signature) Date / Time	ction Agenc	ampling (_	eur Eur	PA EN	E 25 E	si [타일) X			$\frac{1}{1}$		ed for La		Received	Received	Received (Signatur	Pink - CLASS Copy Vallow - 1 sh Cony for Batura to CLASS
On Site Spill ID Site Spill ID Site Spill ID Site Spill ID Signature)	antal Prote atory Progr	ion No. S	ar (Name,	동	•.	۰.	m & 809 \zea			$\frac{1}{1}$		to be Us					
Signature) On Site Spill 10 Site Spill 10 Site Spill 10 Site Spill 10 On Site Spill 10 Signature)	Environm tract Labor	2. Reg	Sample	Sample	3. Pur		AOV			\prod		ample(s)		Date / Tr	Date / Ti	Date / Ti	Turn to Be
Signaturn Signaturn	nited States Con	Code				<u>0</u>	ample Pre Comp. (final		-	+	-	1					Blue - Region Copy White - Lab Copy for Return to Region
Α Ε Θ Ε Θ Ε Θ Ε Θ Ε Θ Ε Θ Ε Θ Ε Θ Ε Θ Ε		Account		E		Site Spi	High Son			\dagger		Pag		nature)	nature)	nature)	· Region (
Gase (IN)			ımation	nd Progn			A Matrix (from Box 6)					Case		by: (Sig	by: (Sig	by: (Sig	
Regional Information Non-Superfund Program Site Name City, State Site Name (from Numbers (from Numbers) (from N		roject Co	jional Info	-Superfu	Name	, State	CLP Sample 'umbers (from labels)					ment for		nquished	nquished	nquished	DISTRIBUTION:

Section No.: 5
Page: 5 of 17
Revision No.: 1
Date: March 2000

FIGURE 5-2 FOSTER WHEELER ENVIRONMENTAL CHAIN OF CUSTODY FORM (TYPICAL)

SPECIFY CHEMICALS ADDED AND FINAL PH IF KNOWN PRESERVATION ICED Shipped via: REMARKS OR SAMPLE LOCATION Date / Time Date / Time FOSTER WHEELER ENVIRONMENTAL CORPORATION \bigcirc Relinquished by: (Signature) Received for Laboratory by: (Signature) CHAIN OF CUSTODY RECORD Received by: (Signature) Received by: (Signature) Received by (Signature) NO. CONTAINERS BARD COME Date / Time Date / Time Date / Time DATE Θ (e) **⊚** Relinquished by: (Signature) Relinquished by: (Signature) Relinquished by: (Signature) SAMPLE NUMBER SAMPLERS: (Signature) PROJECT

Section No.: 5
Page: 6 of 17
Revision No.: 1
Date: March 2000

When the samples are being shipped by an overnight delivery service to the laboratory, the chain of custody form and any other paperwork shall be checked against the sample labels and field documentation, and then placed in a waterproof sealable plastic bag and taped securely to the inside lid of the cooler. The cooler must then be secured, with custody seals affixed over the lid opening in at least two locations, and the cooler wrapped with strapping tape (without obscuring the custody seals). Orientation "this end up" arrows shall be drawn or attached on two sides of the cooler, and a completed overnight delivery service shipping label shall be attached to the top of the cooler. Wide, clear tape should be used to secure the label to the cooler to prevent the shipping address label from being accidentally peeled off the cooler top.

Samples to be shipped by an overnight delivery service shall be shipped within 24 hours of sample collection and arrive at the laboratory within 24 hours of sample shipment. A member of the field team will contact the CLASS office (for RAS samples) or the laboratory directly (for non-RAS samples), to notify them of a sample shipment.

When a courier service is collecting the samples directly from the site (non-RAS shipments only), the chain of custody form shall not be placed inside the cooler. The sample cooler(s) will be secured, with custody seals affixed over the lid opening in at least two locations, and the cooler wrapped with strapping tape (without obscuring the custody seals). Orientation "this end up" arrows shall be drawn or attached on two sides of the cooler. The chain of custody form must be signed by the courier as receiving possession of the samples.

5.2.2 <u>Laboratory Custody Procedures</u>

The following generally summarizes laboratory custody procedures; more detailed operations are presented in the laboratory's SOPs.

- A designated sample custodian will accept custody of the shipped samples and will verify that the information on the sample labels matches that on the chain of custody record(s);
- The laboratory custodian will use the sample label number or assign a unique laboratory number to each sample label and will assure that all samples are transferred to the proper analyst or stored in the appropriate secure area; and,.
- Laboratory personnel are responsible for the care and custody of samples from the time they are received until the sample is exhausted or returned to the custodian or sample storage area. Internal chain of custody records shall be maintained by the laboratory.

Section No.: 5
Page: 7 of 17
Revision No.: 1
Date: March 2000

The laboratory shall communicate with CLASS (for RAS samples) or Foster Wheeler Environmental (for non-RAS samples) personnel by telephone or facsimile, as necessary, throughout the process of sample scheduling, shipment, analysis and data reporting, to ensure that samples are properly processed. If a problem occurs during sample shipment or receipt (e.g., a sample container arrives broken or with insufficient sample volume, a sample was not preserved correctly, a sample was not listed on the chain of custody, etc.), the laboratory shall immediately notify the appropriate person, for resolution. Corrective actions shall be documented and approved before implementation; see Section 13.0.

When sample analyses and necessary QA checks have been completed in the laboratory, the unused portion of the sample and the sample container must be disposed of properly. All identifying tags, data sheets, and laboratory records shall be retained as part of the permanent documentation. Samples received by the laboratory will be retained until analyses and QA checks are completed.

5.3 SAMPLE DOCUMENTATION

5.3.1 Sample Logbook

A cumulative sampling log will be maintained by the FOL or his designee as the field program progresses. All of the samples will be referenced by sampling location in this master log and on a detailed site map. The log data will be maintained as the table of contents for the sample logbook. The sample logbook shall be a loose-leaf notebook containing sample log sheets, as shown in Figure 5-3; floor dust sample data sheets, as shown in Figure 5-4; or pages of a similar data management format, which includes all the necessary information items. A sample log sheet (or equivalent) must be filled out for each sample from the information recorded in the field notebooks (see Section 5.3.2).

5.3.2 Site and Field Logbooks

A bound weatherproof master site logbook will be kept by the FOL or an otherwise designated holder. The site logbook is a controlled document that records all major on-site activities during the field investigation. At a minimum, the site logbook shall contain an abbreviated version of the notes listed in the team or individual field logbooks, a summary of sampling identifiers and shipment information, visitor's names and arrival/departure times, community contacts, and other site-specific

Section No.: 5
Page: 8 of 17
Revision No.: 1
Date: March 2000

FIGURE 5-3 SAMPLE LOG SHEET (TYPICAL)

I.	SAMPLE IDENTIFICATION				
	PA WAM:		ROJECT MAN	IAGER:	
SITE:					
SAMI	PLE NAME/NUMBER:		DATE:	TIME:	HRS
SAMI	PLING LOCATION/DEPTH: $_$		TYPE:	_ GRAB:	_ COMPOSITE
SAMI	PLE MATRIX:SURFAC			WATER	SEDIMENT
					1
	OTHER	(SPECIFY)			
SAMI	PLED BY:				
П.	SAMPLE SOURCE				
	WELL	0	UTFALL		LEACHATE
	DRUM	B0	DRINĠ		RIVER/STREAM
	BLDG/STRUCTURES	TA	ANK		IMPOUNDMENT
	TEST PIT/TRENCH	07	THER (SPECI		
APPE	FIELD OBSERVATIONS/ME				
VOLA	ATILE ORGANIC ANALYSIS	(VOA):	HNU _	OVA	OTHER
VOA	READINGS: OFF SAMPLE		_ RESPIRAT	ORY ZONE	
LEL/C	O ₂ /H ₂ S READINGS:				
RADI	(OACTIVITY (mR/hr):				
pH: _	CONDUCTIVI	TY:	TEMPE	RATURE _	
SALI	NITY:	OTHER:			
OBSE	ERVATIONS:			· · · · · · · · · · · · · · · · · · ·	
IV.	SAMPLE DISPOSITION				
PRES	ERVATION:				
	DRATORY NAME:				
LABO	DRATORY LOCATION:	ON-SITE		OFF-SITE	
	VARDED TO LABORATORY:				
LABC	DRATORY SAMPLE NO.:				
CHAI	N OF CUSTODY NO.:		FED EX N	O.:	
V.	ADDITIONAL REMARKS				

Section No.: <u>5</u> Page: <u>9</u> of <u>17</u> Revision No.: 1 Date: March 2000

FIGURE 5-4 FLOOR DUST SAMPLE DATA SHEET (TYPICAL)

I. <u>SAMPLE IDEN</u> T	<u>CIFICATION</u>				
			JECT MAN		
SAMPLE NUMBER:		DAT			hrs
LOCATION SAMPLED:					
CRETCH OF A DE A .					
			٠		
		.::		· · · · · · · · · · · · · · · · · · ·	
II. <u>SAMPLE SOUR</u>					
_	BARE FLOOR MULTI-LEVEL CA LEVEL LOOP CA	ARPET	SI	LUSH CARPET HAG CARPET THER	
III. <u>FIELD OBSERV</u>	ATIONS/MEASUREME	ENTS			
TYPE OF VACUUM: _			C	ANISTER	
LAST VACUUMED:					
TOTAL SAMPLE TIME	:minutessec	onds		SURE	
IV. <u>SAMPLE DISPO</u>	<u>osition</u>				
TOTAL WEIGHT OF D					
LABORATORY NAME: Date sent:	TIME:	hrs			
CHAIN OF CUSTODY N	10.:		_ FED EX	NO.:	
V. <u>ADDITIONAL</u> R	EMARKS				

V.

Section No.: 5
Page: 10 of 17
Revision No.: 1
Date: March 2000

information determined by the FOL to be noteworthy. In addition, prior to field work each day, the personnel on the site, the proposed activities and the weather shall be recorded in the site logbook. Discussions of program activities, field difficulties/problems, and deviations from the FSP, the QAPP and/or other site plans (with justification) must also be included in the logbook record, along with corresponding times.

The sampling team or any individual performing a particular field investigation activity shall be required to maintain a field logbook. Each logbook will be controlled and assigned a unique sequential identification (e.g., the second logbook devoted to drilling and soil sampling activities would be designated "Geology Logbook No. 2"). The field logbook shall be a bound weatherproof notebook, and entries to the logbook must be filled out legibly in ink. Pertinent information to be recorded in field logbooks includes all information that is necessary to reconstruct the investigative/sampling operations. Documentation of sample activities in the field logbook shall be completed immediately after sampling at the location of sample collection. Logbook entries shall contain all sample information, including sample number, collection time, location, descriptions, field measurements, and other site- or sample-specific observations. Difficulties with sample recovery and field observations (e.g., staining, visible contamination, etc.) must be noted if encountered.

If photographs are taken as part of the documentation procedure, the name of the photographer, the date, the time, the site name, the site location, and a description of the photo shall be entered sequentially in the field logbook as the photographs are taken. Once developed, the photographic prints shall be numbered in correspondence to the logbook numbers, and the above information shall be placed on the back of the photograph.

Logbook pages (for both the master site logbook and the field logbooks) shall be consecutively numbered, and upon entry of data, the logbook pages require the date and the signature of the responsible project team member at the bottom of each page. Corrections to the logbooks shall consist of a single strike line through the incorrect entry, the new accurate information, the initials of the corrector, and the date of amendment. Any blank spaces/pages in the logbooks shall be crossed out with a single strike mark and signed by the person making the notation.

Section No.: 5
Page: 11 of 17
Revision No.: 1
Date: March 2000

5.3.3 Field Investigation Forms

In addition to field logbooks, field team members will use appropriate forms applicable to the field activities. Boring logs (Figure 5-5) will be used for each soil boring to record the subsurface geology, as will test pit records (Figure 5-6) during test pit excavation activities. A well installation sheet shall detail the construction of the monitoring wells (Figure 5-7). During development of the monitoring wells, a low-flow data sheet for low-flow sampling (Figure 5-8) shall be filled out for each well. A rig shift report would be completed by the Site Geologist for each day of drilling operations (Figure 5-9). During the aquifer pumping test, a pumping test data sheet (Figure 5-10) shall be used for each of the specific wells designated for data collection.

Chain of custody forms shall be used for all sample shipments. These forms are described in Section 5.2.1, and typical forms are presented as Figures 5-1 and 5-2.

Records of calibration attainment and preventive maintenance shall be kept for all field instrumentation used that require daily calibration. Further information on calibration and maintenance procedures can be found in Section 8.0.

5.3.4 On-Site Screening Analysis Records

Field data for the soil gas survey (field GC results), water level measurements, NAPL measurements (if present), field FID/PID soil screening, dissolved oxygen measurements, pH measurements, specific conductivity measurements, temperature measurements, and turbidity measurements will be reported by site personnel in field logbooks and/or on field investigation forms associated with the sampling event (see Sections 5.3.2 and 5.3.3). The soil gas survey data shall be reported by the Subcontractor in a field logbook dedicated to the screening investigation, and will include calibration, duplicate, and spike results and all calculations. In addition, the Site Geologist will be required to maintain a logbook detailing the survey oversight. At the end of the survey portion of the field investigation, the field GC results shall be summarized in tabulated form in the Site Geologist's field logbook, and all chromatograms associated with the analysis will be placed in the project files.

Section No.: <u>5</u>
Page: <u>12</u> of <u>17</u>
Revision No.: <u>1</u>
Date: <u>March 2000</u>

FIGURE 5-5 BORING LOG SHEET (TYPICAL)

G	PROJECT N ROJECT N LOCATIC EOLOGI DRILLI RILLING	IO: DN: ST:	NG MET	HOD:			DAT DATE O JNDWA		RTED: ETED: EPTH:		
SAMPLE ID	DEPTH (feet)	BLOWS per 6"	RECO- VERY	PRO- FILE	USCS CLASS	MATERIAL DESCRIPTION	COLLE Time	CTION Date	HNu/ OVA	COMMENTS	
110	(leet)	per 0	VERI	LILE	CLASS	DESCRIPTION	THILE	Date	(ppm)		
		!									
i		:									
-											
						,					
								-			
				!							
							. —				
		;									
								L			
NOTES:	OTES:										
D. 655 :											
PAGE 1	OF										

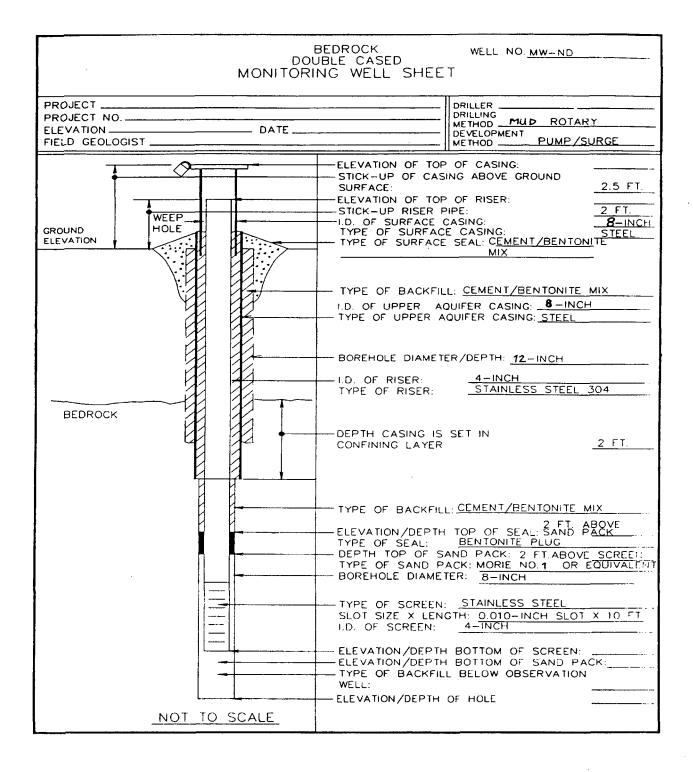
Section No.: <u>5</u>
Page: <u>13</u> of <u>17</u>
Revision No.: <u>1</u>
Date: <u>March 2000</u>

FIGURE 5-6 TEST PIT RECORD (TYPICAL)

		PRO	JECT:								TEST	PIT N	UMBE	R:	
	I	PROJEC	T NO:								DA	TE ST	ARTE	D:	
		LOCA	TION:]	DATE	COME	PLETE	D:	
		GEOLO	GIST:							GROU	JNDW	ATER	DEPT	Н:	
EXC	AVATIO	N COMP	ANY:									·			
						NOT	TO S	CALE	ı						
DEPT 0	H (feet)														HNu/OVA
					,		•		· ·	•			:	:	
			<u></u>		· · · - · · · · ·			· • · · · · · · ·					·	 	
			*				· 	, , ,, , , , , , , , , , , , , , , , ,	· · · · · · · · ·	; ;	• • • • • • • •	· 	<u>.</u>	<u>:</u>	<u> </u>
	:			•	•		•	•			•	•		:	
		· · · · · · · · · · · · · · · · · · ·						,	,		,	· · · · · · · · · · · · · · · · · · ·	,		
			*		· • · · · - ·		<u>.</u>		, , , , , , , , , , , , , , , , , , , ,		· • · · · · ·				
							;	• • •	, , , , , , ,	· ·			· • • • · · · · ·		
	,	:	;		•			•	, , , , , , , , , , , , , , , , , , ,			:		:	.
							; ;	· · · · · · · · · · · · · · · · · · ·	,			· · · · · · · · · · · · · · · · · · ·	3	* · · · · · · · · · · · · · · · · · · ·	
		· · · ·		; ;			* * *	· •		: : :::::::::	<u>.</u>	• • • • • • • •	· ·	<u>.</u>	¦
	•	1	•		· ·	:	· ·		•	:	:	:	•		ı
				* * * * * * * * * * * * * * * * * * *	, , , <u></u> .							*			
		<u>.</u>			, , , , , , , , , , , , , , , , , , , ,	: 	: :	· · · · · · · · ·		: 	: !	: :	:		
	:						· ·	:	•	:		;	:		
0	:								:						
							LENC	STH (fe	eet)						
								-							
NOT	ES:														

Section No.: 5
Page: 14 of 17
Revision No.: 1
Date: March 2000

FIGURE 5-7 BEDROCK MONITORING WELL SHEET (TYPICAL)



300455

Section No.: 5
Page: 15 of 17
Revision No.: 0
Date: March 2000

FIGURE 5-8 LOW-FLOW DATA SHEET (TYPICAL)

Well I.D.:	DATE:
Well Depth (from TOC) = ft	Well Diameter (d) = ft
Static Water Level (WL) = ft (from TOC)	Well Radius (d/2) = ft
Height of Water in Well (T): T = Depth (ft) - Static Water Level (ft) T = T = ft	Gallons of Water per Well Volume: V = 0.163 x T(ft) x r(in) ² V = 0.163 x x ² V = gallons Pump Intake Depth (ft): Pump Flow Rate:
PID/FID Water Level/ Time: (ppm) Drawdown (ft) pH (SU) Temp. (°C)	
FWENC Sampler(s) Present:	

Section No.: 5
Page: 16 of 17
Revision No.: 0
Date: March 2000

FIGURE 5-9 RIG SHIFT REPORT (TYPICAL)

SUBCONTRACTORIG NO.:SITE:DRILLER:		GI H/	S TECHNIC	IAN:			H/S	TE: LEVEL: _	
CONTRACTORS		AM				 -	PM		TOTAL HOURS
ACTIVITIES	6	 7 8		11	12	1 2	 	4 5	
MOBILIZATION									
TRAVEL			<u> </u>		- 				
DRILLING STANDBY			 		┿				
BREAK (H/S)			1						
RIG DOWN (TIME)			 		+				
DECON			 	-	 	 		 	
OTHER					 				
OTHER		· · · · · · · · · · · · · · · · · · ·	ļ						
(EXPLAIN)			<u> </u>						
									_
			SHIFT ACCO	MPLISHN	1ENTS				
HOLE NO								T T	
START									
DEPTH									
END									
SAMPLE NO									
DEPTH									
SAMPLE NO DEPTH			-						
SAMPLE NO			1						
DEPTH			<u> </u>	+		 	-+-		
			<u> </u>			<u> </u>			
NO. HOL	ES COMPLETE	D:	NO. S	AMPLES:			(EXCE	T QA)	
NO. FEE	T DRILLED:		NO. QA SAMPLES:						

*INDICATES SAMPLE FOR CHEMICAL ANALYSIS

Section No. 5 Page: 17 of 17 Revision No.: 0 Date: March 2000

FIGURE 5-10 PUMPING TEST DATA SHEET (TYPICAL)

SITE NAME PROJECT NUMBER DATE(S) OF TEST REMARKS WELL IDENTIFICATION MEASURING POINT DISTANCE FROM PUMPING WELL (r, ft) PUMPING RATE (Q)

ELEV.

TIME TIME SINCE TIME WATER WATER WATER DRAWDOWN RESIDUAL CALCULATED REMARKS RECOVERY DATE PUMP SINCE t/t' LEVEL LEVEL LEVEL DRAWDOWN (24 hr) CORRECTION START (s', ft) PUMP STOP HELD D. T. W. (s, ft) (t. min) (t', min) (ft) (ft) (ft) (s-s', ft)

				` '	 , ,		
						_	
						·	
	 	 	···				
- 1							

Section No.: 6
Page: 1 of 11
Revision No.: 0
Date: March 2000

6.0 ANALYTICAL REQUIREMENTS

The analytical program to be undertaken at the Cornell-Dubilier Site is summarized in Table 6-1. Sample collection and analytical protocol information, which includes the following: sample type, matrix, sampling device, number of samples, analytical parameter, sample container requirements, sample preservation, analytical method, method detection limits, and sample holding times, are presented in Table 6-2.

Results from the analyses are to be reported in standard units for the matrix and analysis. For further information on reporting units, see Tables 3-5 and 6-2.

All analytical services required for the Cornell-Dubilier project shall be procured in accordance with Foster Wheeler Environmental's RAC II <u>Delivery of Analytical Services Plan</u> (Foster Wheeler Environmental, 1998). RAS parameter laboratory services will be provided by USEPA CLP laboratories. Non-RAS services will be provided by subcontracted laboratories (see Attachment 1 for a condensed overview of the procurement process).

Date: March 2000

TABLE 6-1 SUMMARY OF ANALYTICAL PROGRAM - RECONNAISSANCE PHASE AND PHASE I INVESTIGATION

Sample Type	Target Volatile Organic Compounds	TCL Volatile Organic Compounds	TCL Semi- Volatile Organic Compounds	TCL Pesticide/PCB Compounds	TCL PCB Compounds	PCB Congeners	Low Concentration Volatile Organic Compounds	Low Concentration Semi-Volatile Organic Compounds	Low Concentration Pesticide/PCB Compounds	Low Concentration PCBs	TAL Metals	Cyanide	Geotechnical Parameters	Haloacetic Acids	Water Quality Parameters	Field : Measurements
SOIL GAS	225 (12)								,							
SOILS																
Test Pit		10 (1)	10 (1)	10 (1)				7			10 (1)	10 (1)				į
Residential/Commercial					849 (43)											
Surface		21 (2)	21 (2)	21 (2)		3 (1)					21 (2)	21 (2)	21 (2)*			
Subsurface Well Borings		44 (3)	44 (3)	44 (3)		3 (1)					44 (3)	44 (3)	44 (3)			
Subsurface Building Borings		144 (8)	144 (8)	144 (8)							144 (8)	144 (8)				
GROUNDWATER																
Test Pit							10 (1)	10 (1)	10 (1)		10 (1)	10 (1)				
Hydropunch							11 (1)			11 (1)						
Phase I Wells [Round I]						3 (1)	11 (1)	11 (1)	11 (1)		11 (1)	11 (1)		11 (1)	11 (1)	11
DRAINAGE SYSTEM																.'
Standing Water							5 (1)	5 (1)	5 (1)		5 (1)	5 (1)				
Sediment		5 (1)	5 (1)	5 (1)							5 (1)	5 (1)				
BUILDING INTERIOR (FLOOR DUST)					24 (2)						24 (2)					
BLANKS																
Field			48	48	44	8	21	10	10	11	66	58				
Drilling Water							2	2	2		2	2				
Trip							21									
DI Water							2	2	2		2	. 2				
Total	225 (12)	224 (15)	272 (15)	272 (15)	917 (45)	17 (3)	83 (4)	40 (3)	40 (3)	22 (1)	344 (20)	312 (18)	65 (5)	11 (1)	11 (1)	11

Notes:

- The number provided in parentheses denotes the number of field environmental duplicate samples. The table does not include laboratory QA/QC samples.

 Low concentration volatile organic compound, semi-volatile organic compound, and pesticide and PCB parameter list stated in OLC02.1 or latest revision.

 TCL volatile organic compound, semi-volatile organic compound, and pesticide and PCB parameter list stated in OLM04.2 or latest revision.

 Metal parameter list stated in ILM04.1 or latest revision.

 Geotechnical parameters include grain size and/or total organic carbon.

 Water quality parameters include total organic carbon, dissolved organic carbon, total suspended solids, total dissolved solids, ammonia, nitrate-nitrite, total phosphorus, hardness, chloride, chlorite, and bromate. The number of QA/QC blanks are estimated on the basis of one trip blank per day when aqueous VOC samples are collected, and one field blank per decontamination event (not to exceed one per day per type of sampling equipment).
- *TOC only.

(Sheet 1 of 9)

		-							
Sample Type	Matrix	Sampling Device	No. of Samples	<u>Parameter</u>	Sample Container	Sample Preservation	Analytical Method	Practical Quantitation Limit	Holding Time
Soil Gas	Air	Syringe	224 (12)	Target Volatile Organic Compounds [Non-CLP]	Syringe	NA	Direct Measurement by Field GC	25 ug/L	Analyze immediately
Test Pit Soil	Soil	EnCore® Sampler	10 (1)	TCL Volatile Organic Compounds [CLP]	(3) EnCore® Samplers	Cool to 4°C	OLM04.2 or latest revision	10 ug/kg (low soils); 1200 ug/kg (medium soils)	48 hours*
		Stainless steel scoop, trowel or shovel	10 (1)	Percent Moisture ** [CLP]	(1) 60 ml glass jar	NA .	OLM04.2 or latest revision	NA	NA
			10 (1)	TCL Semi-Volatile Organic Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (330-830 ug/kg)	10 days extract; 40 days analyze
			10 (1)	TCL Pesticide/PCB Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (1.7-170 ug/kg)	10 days extract; 40 days analyze
			10 (1)	TAL Metals [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	Element Specific (0.04-1000 mg/kg)	180 days (Hg-26 days)
			10(1)	Cyanide [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	10 mg/kg	12 days
Residential/ Commercial Soil	Soil	Stainless steel scoop or trowel	659 (33)	TCL PCB Compounds [Non-CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (33-67 ug/kg)	10 days extract; 40 days analyze
		Hand auger, stainless steel scoop or trowel	190 (10)	TCL PCB Compounds [Non-CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (33-67 ug/kg)	10 days extract; 40 days analyze
Surface Soil	Soil	EnCore® Sampler	21 (2)	TCL Volatile Organic Compounds [CLP]	(3) EnCore® Samplers	Cool to 4°C	OLM04.2 or latest revision	10 ug/kg (low soils); 1200 ug/kg (medium soils)	48 hours *
		Stainless steel scoop or trowel	21 (2)	Percent Moisture ** [CLP]	(1) 60 ml glass jar	NA	OLM04.2 or latest revision	NA	NA
300460			21 (2)	TCL Semi-Volatile Organic Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (330-830 ug/kg)	10 days extract; 40 days analyze

(Sheet 2 of 9)

Sample Type	Matrix	Sampling Device	No. of Samples	Parameter	Sample Container	Sample Preservation	Analytical Method	Practical Quantitation Limit	Holding Time
			21 (2)	TCL Pesticide/PCB Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (1.7-170 ug/kg)	10 days extract; 40 days analyze
			3 (1)	PCB Congeners	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	SW846 Method 8082	Congener Specific (0.16-0.8 ug/kg)	10 days extract; 40 days analyze
			21 (2)	TAL Metals [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	Element Specific (0.04-1000 mg/kg)	180 days (Hg-26 days)
			21 (2)	Cyanide [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	10 mg/kg	12 days
			21 (2)	Total Organic Carbon [Non-CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	L. Kahn Method (7/88)	100 mg/kg	14 days
Subsurface Soil (Well Borings)	Soil	Split-spoon, EnCore® Sampler	44 (3)	TCL Volatile Organic Compounds [CLP]	(3) EnCore® Samplers	Cool to 4°C	OLM04.2 or latest revision	10 ug/kg (low soils); 1200 ug/kg (medium soil)	48 hours *
		Split-spoon, stainless steel scoop	44 (3)	Percent Moisture ** [CLP]	(1) 60 ml glass jar	NA	OLM04.2 or latest revision	NA	NA .
			44 (3)	TCL Semi-Volatile Organic Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool.to 4°C	OLM04.2 or latest revision	Compound specific (330-830 ug/kg)	10 days extract; 40 days analyze
			44 (3)	TCL Pesticide/PCB Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (1.7-170 ug/kg)	10 days extract; 40 days analyze
			3 (1)	PCB Congeners	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	SW846 Method 8082	Congener specific (0.16-0.8 ug/kg)	10 days extract; 40 days analyze
300461			44 (3)	TAL Metals [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	Element Specific (0.04-1000 mg/kg)	180 days (Hg-26 days)
461			44 (3)	Cyanide [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	10 mg/kg	12 days
			44 (3)	Total Organic Carbon [Non-CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	L. Kahn Method (7/88)	100 mg/kg	14 days

(Sheet 3 of 9)

Sample Type	Matrix	Sampling Device	No. of Samples	Parameter	Sample Container	Sample Preservation	Analytical Method	Practical Quantitation Limit	Holding Time
			44 (3)	Grain Size [Non-CLP]	(1) 8 oz. glass jar w/Teflon lined cap	NA	ASTM Method D422	NA	NA
Subsurface Soil (Building Borings)	Soil	EnCore® Sampler	144 (8)	TCL Volatile Organic Compounds [CLP]	(3) Encore® Samplers	Cool to 4°C	OLM04.2 or latest revision	10 ug/kg (low soils); 1200 ug/kg (medium soils)	48 hours *
		Hand auger, stainless steel scoop	144 (8)	Percent Moisture ** [CLP]	(1) 60 ml glass jar	NA	OLM04.2 or latest revision	NA	NA
			144 (8)	TCL Semi-Volatile Organic Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (330-830 ug/kg)	10 days extract; 40 days analyze
			144 (8)	TCL Pesticide/PCB Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (1.7-170 ug/kg)	10 days extract; 40 days analyze
			144 (8)	TAL Metals [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	Element Specific (0.04-1000 mg/kg)	180 days (Hg-26 days)
			144 (8)	Cyanide [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	10 mg/kg	12 days
Groundwater (Test Pits)	Water	Direct fill, stainless steel scoop or stainless steel beaker	10(1)	Low Concentration Volatile Organic Compounds [CLP]	(4) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; Cool to 4°C	OLC02.1 or latest revision	Compound specific (1-5 ug/L)	10 days
			10 (1)	Low Concentration Semi-Volatile Organic Compounds [CLP]	(2) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (5-20 ug/L)	5 days extract; 40 days analyze
300			10 (1)	Low Concentration Pesticides/PCBs [CLP]	(2) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (0.01-1 ug/L)	5 days extract; 40 days analyze
00462			10 (1)	TAL Metals [CLP]	(1) 1 L polyethylene	HNO ₃ to pH<2; Cool to 4°C	ILM04.1 or latest revision	Element specific (0.2-5000 ug/L)	6 months (Hg-26 days)
			10 (1)	Cyanide [CLP]	(i) i L polyethylene	NaOH to pH>12; Cool to 4°C	ILM04.1 or latest revision	10 ug/L	12 days

(Sheet 4 of 9)

Sample Type	Matrix	Sampling Device	No. of Samples	<u>Parameter</u>	Sample Container	Sample Preservation	Analytical Method	Practical Quantitation Limit	Holding Time
Groundwater (Hydropunch)	Water	Hydropunch sampler	11 (1)	Low Concentration Volatile Organic Compounds [CLP]	(4) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; Cool to 4°C	OLC02.1 or latest revision	Compound specific (1-5 ug/L)	10 days
			11 (1)	Low Concentration PCBs [Non-CLP]	(1) I L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (0.2-0.4 ug/L)	5 days extract; 40 days analyze
Groundwater (Phase I Wells)	Water	Low flow pump	11 (1)	pH; temperature; conductivity; Eh; dissolved oxygen; turbidity [Non-CLP]	NA	NA ·	Field measurement	NA .	NA
			11 (1)	Low Concentration Volatile Organic Compounds [CLP]	(4) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; Cool to 4°C	OLC02.1 or latest revision	Compound specific (1-5 ug/L)	10 days
			11 (1)	Low Concentration Semi-Volatile Organic Compounds [CLP]	(2) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (5-20 ug/L)	5 days extract; 40 days analyze
			11 (1)	Low Concentration Pesticides/PCBs [CLP]	(2) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (0.01-1 ug/L)	5 days extract; 40 days analyze
			3 (1)	PCB Congeners	(i) 1 L amber glass w/Teflon lined cap	Cool to 4°C	SW846 Method 8082	Congener specific (0.005-0.025 ug/L)	5 days extract; 40 days analyze
			11 (1)	TAL Metals [CLP]	(1) 1 L polyethylene	HNO ₃ to pH<2; Cool to 4°C	ILM04.1 or latest revision	Element specific (0.2-5000 ug/L)	6 months (Hg-26 days)
300463			11 (1)	Cyanide [CLP]	(1) I L polyethylene	NaOH to pH>12; Cool to 4°C	ILM04.1 or latest revision	10 ug/L	12 days
			11 (1)	Haloacetic Acids [Non-CLP]	(1) 250 ml amber glass w/Teflon lined cap	25 mg of ammonium chloride (NH ₄ CL); Cool to 4°C	USEPA Method 552.2	Compound specific (0.2-1.5 ug/L)	14 days *extract; 7 days * analyze
(11 (1)	TOC [Non-CLP]	(1) 1 L amber glass	H ₂ SO ₄ to pH<2; cool to 4°C	MCAWW 415.1	1 mg/L	28 days

(Sheet 5 of 9)

Sample Type	<u>Matrix</u>	Sampling Device	No. of Samples	<u>Parameter</u>	Sample Container	Sample Preservation	Analytical Method	Practical Quantitation Limit	Holding Time
			11 (1)	DOC [Non-CLP]	(1) 1 L amber glass	Filter in field with 0.45 um filter; H ₂ SO ₄ to pH<2; Cool to 4°C	MCAWW 415.1	1 mg/Ļ	28 days
			11 (1)	TSS [Non-CLP]	(1) 250 ml PE	Cool to 4°C	MCAWW 160.2	4 mg/L	7 days
			11 (1)	TDS [Non-CLP]	(1) 250 ml PE	Cool to 4°C	MCAWW 160.1	10 mg/L	7 days
			11 (1)	Ammonia [Non-CLP]	(1) 500 ml PE	H ₂ SO ₄ to pH<2; cool to 4°C	MCAWW 350.3	0.01 mg/L	28 days
·			11 (1)	Nitrate-Nitrite [Non-CLP]	(1) 250 ml PE	H ₂ SO ₄ to pH<2; cool to 4°C	MCAWW 353.2	0.01 mg/L	48 hours *
			11 (1)	Total Phosphorus [Non-CLP]	(1) 250 ml PE	H ₂ SO ₄ to pH<2; cool to 4°C	MCAWW 365.2	0.01 mg/L	28 days
			11 (1)	Hardness [Non-CLP]	(1) 250 ml PE	HNO ₃ to pH<2; cool to 4°C	MCAWW 200.7	10 mg/L	6 months
			11 (1)	Chloride [Non-CLP]	(1) 250 ml PE	Cool to 4°C	MCAWW 325.3	I mg/L	28 days
			11 (1)	Chlorite [Non-CLP]	(1) 250 mgl amber glass	0.125 ml ethylene- diamine (EDA) preservation solution; cool to 4°C	USEPA Method 300.1	Lab Determined (~ 0.9 ug/l)	14 days *
			11 (1)	Bromate [Non-CLP]	(1) 250 ml PE	0.125 ml EDA preservation solution; cool to 4°C	USEPA Method 300.1	Lab Determined (~ 1.5 ug/l)	28 days *
Drainage System Standing Water	Water	Beaker, scoop or direct fill	5 (1)	Low Concentration Volatile Organic Compounds [CLP]	(4) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; Cool to 4°C	OLC02.1 or latest revision	Compound specific (1-5 ug/L)	10 days
300464			5 (1)	Low Concentration Semi-Volatile Organic Compounds [CLP]	(2) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (5-20 ug/L)	5 days extract; 40 days analyze

(Sheet 6 of 9)

Sample Type	<u>Matrix</u>	Sampling Device	No. of Samples	<u>Parameter</u>	Sample Container	Sample Preservation	Analytical Method	Practical Quantitation Limit	Holding Time
			5 (1)	Low Concentration Pesticides/PCBs [CLP]	(2) I L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (0.01-1 ug/L)	5 days extract; 40 days analyze
			5 (1)	TAL Metals [CLP]	(1) 1 L polyethylene	HNO ₃ to pH<2; Cool to 4°C	ILM04.1 or latest revision	Element specific (0.2-5000 ug/L)	6 months (Hg-26 days)
			5 (1)	Cyanide [CLP]	(1) 1 L polyethylene	NaOH to pH>12; Cool to 4°C	ILM04.1 or latest revision	10 ug/L	12 days
Drainage System Sediment	Sediment	EnCore® Sampler	5 (1)	TCL Volatile Organic Compounds [CLP]	(3) EnCore® Samplers	Cool to 4°C	OLM04.2 or latest revision	10 ug/gk (low soils); 1200 ug/kg (medium soils)	48 hours *
		Stainless steel scoop, trowel, shovel or remote device	5 (1)	Percent Moisture ** [CLP]	(1) 60 ml glass jar	NA	OLM04.2 or latest revision	NA	NA
			5 (1)	TCL Semi-Volatile Organic Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (330-830 ug/kg)	10 days extract; 40 days analyze
٠			5 (1)	TCL Pesticide/PCB Compounds [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool.to 4°C	OLM04.2 or latest revision	Compound specific (1.7-170 ug/kg)	10 days extract; 40 days analyze
30046			5 (1)	TAL Metals [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	Element Specific (0.04-1000 mg/kg)	180 days (Hg-26 days)
65			5 (1)	Cyanide [CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	ILM04.1 or latest revision	10 mg/kg	12 days
Building Interior	Floor Dust	Modified vacuum	24 (2)	TCL PCB Compounds [Non-CLP]	(1) 8 oz. glass jar w/Teflon lined cap	Fold into pre-cleaned aluminum foil; place in jar; cool to 4°C	OLM04.2 or latest revision	Compound specific (33-67 ug/kg)	10 days extract; 40 days analyze
			24 (2)	TAL Metals [Non-CLP]	(1) polyethylene "zipper" bag	Cool to 4°C	ILM04.1 or latest revision	Element Specific (0.04-1000 mg/kg)	180 days (Hg-26 days)
Field Blank (solids)	Water	Collected Rinsate Passed Over/ Through Sampling Equipment	48	TCL Semi-Volatile Organic Compounds [CLP]	(2) I L amber glass w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (10-25 ug/L)	5 days extract; 40 days analyze

(Sheet 7 of 9)

Sample Type	<u>Matrix</u>	Sampling Device	No. of Samples	<u>Parameter</u>	Sample Container	Sample Preservation	Analytical Method	Practical Quantitation Limit	Holding Time					
			48	TCL Pesticide/PCB Compounds [CLP]	(2) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specific (0.05-5 ug/L)	5 days extract; 40 days analyze					
			44	TCL PCBs [Non-CLP]	(1) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLM04.2 or latest revision	Compound specifid (1-2 ug/l)	5 days extract; 40 days analyze					
			48	TAL Metals [CLP]	(1) 1 L polyethylene	HNO ₃ to pH<2; Cool to 4°C	ILM04.1 or latest revision	Element specific (0.2-5000 ug/l)	6 months (Hg-26 days)					
			8	TAL Metals [Non-CLP]	(1) I L polyethylene	HNO ₃ to pH<2; Cool to 4°C	ILM04.1 or latest revision	Element specific (0.2-5000 ug/l)	6 months (Hg-26 days)					
			48	Cyanide [CLP]	(1) 1 L polyethylene	NaOH to pH>12; Cool to 4°C	ILM04.1 or latest revision	10 ug/L	12 days					
Field Blank (groundwater)	Water	Collected Rinsate Passed Over/ Through Sampling Equipment	18	Low Concentration Volatile Organic Compounds [CLP]	(4) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; Cool to 4°C	OLC02.1 or latest revision	Compound specific (1-5 ug/l)	10 days					
								7	Low Concentration Semi-Volatile Organic Compounds [CLP]	(2) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (5-20 ug/L)	5 days extract; 40 days analyze
						7	Low Concentration Pesticides/PCBs [CLP]	(2) 1 L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (0.01-1 ug/L)	5 days extract; 40 days analyze		
			11	Low Concentration PCBs [Non-CLP]	(1) I L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (0.01-1 ug/L)	5 days extract; 40 days analyze					
3004			7	TAL Metals [CLP]	(1) 1 L polyethylene	HNO ₃ to pH<2; Cool to 4°C	ILM04.1 or latest revision	Element specific (0.2-5000 ug/l)	6 months (Hg-26 days)					
466			7	Cyanide [CLP]	(1) 1 L polyethylene	NaOH to pH>12; Cool to 4°C	ILM04.1 or latest revision	10 ug/L	12 days					
Drilling Water Blank	Water	Direct Fill of Sample Bottles	2	Low Concentration Volatile Organic Compounds [CLP]	(4) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; Cool to 4°C	OLC02.1 or latest revision	Compound specific (1-5 ug/l)	10 days					

(Sheet 8 of 9)

Sample Type	<u>Matrix</u>	Sampling Device	No. of Samples	<u>Parameter</u>	Sample Container	Sample Preservation	Analytical Method	Practical Quantitation Limit	Holding Time
			2	Low Concentration Semi-Volatile Organic Compounds [CLP]	(2) I L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (5-20 ug/L)	5 days extract; 40 days analyze
			2	Low Concentration Pesticides/PCBs [CLP]	(2) I L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (0.01-1 ug/L)	5 days extract; 40 days analyze
			2	TAL Metals [CLP]	(1) I L polyethylene	HNO ₃ to pH<2; Cool to 4°C	ILM04.1 or latest revision	Element specific (0.2-5000 ug/l)	6 months (Hg-26 days)
			2	Cyanide [CLP]	(1) 1 L polyethylene	NaOH to pH>12; Cool to 4°C	ILM04.1 or latest revision	10 ug/L	12 days
Trip Blank	Water	Direct Fill of Sample Bottles	18	Low Concentration Volatile Organic Compounds [CLP]	(4) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; Cool to 4°C	OLC02.1 or latest revision	Compound specific (1-5 ug/l)	10 days
DI Water Blank	Water	Direct Fill of Sample Bottles	2	Low Concentration Volatile Organic Compounds [CLP]	(4) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; Cool to 4°C	OLC02.1 or latest revision	Compound specific (1-5 ug/L)	10 days
			2	Low Concentration Semi-Volatile Organic Compounds [CLP]	(2) I L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (5-20 ug/L)	5 days extract; 40 days analyze
			2	Low Concentration Pesticides/PCBs [CLP]	(2) I L amber glass w/Teflon lined cap	Cool to 4°C	OLC02.1 or latest revision	Compound specific (0.01-1 ug/L)	5 days extract; 40 days analyze
з 0			2	TAL Metals [CLP]	(1) 1 L polyethylene	HNO, to pH<2; Cool to 4°C	ILM04.1 or latest revision	Element specific (0.2-5000 ug/L)	6 months (Hg-26 days)
00467			2	Cyanide [CLP]	(1) 1 L polyethylene	NaOH to pH>12; Cool to 4°C	ILM04.1 or latest revision	10 ug/L	12 days

(Sheet 9 of 9)

Sample Type Matrix Sampling Device No. of Samples Parameter Sample Container Sample Preservation Analytical Method Practical Quantitation Limit Holding Time

Notes:

All holding times listed are from Verified Time of Sample Receipt (VTSR) unless noted otherwise (* denotes from time of sample collection). The number in parentheses in the "No. of Samples" column denotes the number of duplicate samples. The number in parentheses in the "Sample Container" column denotes the number of containers needed. Triple volume is required for OLC02.1 QA/QC sample analyses at a frequency of 1 per 20 samples. Triple volume is required for OLM04.2 MS/MSD sample analyses at a frequency of 1 per 20 samples. The number of field, drilling water, trip and DI water blanks are estimated.

OLM04.2 = USEPA Contract Laboratory Program Statement of Work for Organic Analyses.

ILM04.1 = USEPA Contract Laboratory Program Statement of Work for Inorganic Analyses.

OLC02.1 = USEPA Contract Laboratory Program Statement of Work for Low Concentration Water Samples for Organic Analyses.

MCAWW = Methods for Chemical Analysis of Water and Wastes.

SW846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

ASTM = American Society for Testing and Materials.

NA = Not available or not applicable.

TOC = Total Organic Carbon

DOC = Dissolved Organic Carbon

TSS = Total Suspended Solids

TDS = Total Dissolved Solids

All bottles will comply with OSWER Directive 9240.0-05A: "Specifications and Guidance for Obtaining Contaminant - Free Sample Containers", EPA 540/R-93/051, December 1992.

^{**} Samples for percent moisture will <u>only</u> be collected if the TCL VOC samples are shipped to a separate laboratory from the TCL SVOC and/or TCL pesticide/PCB samples.

Section No.: 7
Page: 1 of 3
Revision No.: 1
Date: March 2000

7.0 SUPPLIES AND CONSUMABLES

Supplies and consumables necessary for the field investigation will be obtained through appropriate commercial markets and shall meet any supply-specific requirements outlined in the FSP and/or this QAPP. All supplies and consumables will be inspected by Foster Wheeler Environmental personnel (e.g., the FOL, the Site Geologist, the Site Chemist) prior to use. Any supplies/consumables that do not meet requirements will be discarded or returned to the supplier.

Supply-specific requirements include the following:

- Sampling equipment shall be manufactured from the procedural-specific material (e.g., carbon steel split-spoons for soil boring sampling, Teflon bailers for groundwater sampling, etc.).
- Sample bottle containers will meet all guidelines specified in <u>Specification and Guidance for Obtaining Contaminant-Free Sample Containers</u>, EPA 540/R-93/051 and OSWER Directive 9240.0-05A (USEPA, 1992). Certifications from the supplier will be retained in the project files.
- The field QC sample water will be distilled, deionized water that is contaminant-free. Certifications from the supplier will be retained in the project files. In addition, a sample of the water will be sent to the RAS laboratory for verification analysis.
- The drilling subcontractor will provide a potable water supply for equipment decontamination. Any necessary permits or testing will be obtained by the subcontractor with review/approval by Foster Wheeler Environmental. Documentation of the potable water source will be retained in the project files.
- Preservation chemical supplies (e.g., methanol, hydrochloric acid, etc.) will be of analytical reagent grade or better. Certifications from the supplier must be provided and retained in the project files.
- Decontamination chemical supplies shall be of ultra pure grade (nitric acid) and pesticide grade (methanol and hexane) or better. Certifications from the supplier will be provided and retained in the project files.

Section No.: 7
Page: 2 of 3
Revision No.: 1
Date: March 2000

 Field screening instrumentation supplies shall be of procedural- and/or manufacturerspecific grade.

Supplies and consumables will be stored, as necessary, in a designated area on the site. The storage area shall be protected from adverse conditions (e.g., weather, heat, etc.) to protect the supplies/consumables from possible outside contamination and breakage.

Materials purchased or obtained from Foster Wheeler Environmental inventory for the field investigation activities which will be used on-site and returned to inventory, i.e., not be consumed (e.g., hammer, rope) shall be documented using a Material Received Report (MRR) form and a store receipt (if applicable). A typical MRR form is shown as Figure 7-1. MRRs shall be numbered serially, starting with the number "01". A copy of the MRR must be maintained at the site and in the project management files.

Section No.: 7
Page: 3 of 3
Revision No.: 1
Date: March 2000

FIGURE 7-1 MATERIAL RECEIVED REPORT (MRR) FORM (TYPICAL)

PAGE OF			MRR NO.:			
RECEIV	ED AT:		P.O.	NO.:		
VENDO	R:	DAT	`E:			
SHIPPE	R:	CAR	RIER:			
SHIPPE	D FROM:	PRO	JECT NO.:			
RECEIV	ED BY:		LLECT PAID \$			
RECEIVEI *Note any si		IECES □ BOXES □ CARTONS □ in space provided below*	BAGS	S BUNDLES		
ITEM	QUANTITY	DESCRIPTION		DATE RETURNED TO INVENTORY/INITIALS		
		·				
_	1					
-						
_						
*REPORT If discrepancy description of the carrier's re	is discovered prior to any damage or shorts	ORTAGE DAMAGE DOVERSHIPMENT - REF: JO acceptance of shipment, obtain endorsement on delivery receipt and freight bill age and the condition of any damaged containers, even though the contents are affixed to such endorsements.	DINT II I by carr re in app	NSPECTION REPORT NO rier's representative, giving detailed parent good order. The signature of		
ITEM	QUANTITY	DESCRIPTION				
:						

Section No.: <u>8</u>
Page: <u>1</u> of <u>4</u>
Revision No.: <u>1</u>
Date: <u>March 2000</u>

8.0 INSTRUMENT CALIBRATION AND PREVENTIVE MAINTENANCE

8.1 CALIBRATION

This section describes the requirements for control, calibration, and adjustment (if necessary) of instrumentation. Instruments shall be calibrated and adjusted (if warranted) at specified, predetermined intervals using known, recognized standards. All instruments shall be calibrated in accordance with manufacturer's instructions.

8.1.1 Field Instrumentation

The FOL or his designee will be responsible for ensuring that instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to their specific calibration protocols/procedures.

All field measurement instruments must be calibrated according to the manufacturer's instructions prior to the commencement of the day's activities. Exceptions to this requirement shall be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer. QC objectives for field measurement parameters are presented in Table 3-5. Calibration information shall be documented on instrument calibration and maintenance log sheets (see Figure 8-1 for a typical form) or in a designated field logbook. Information to be recorded includes the date, the operator, and the calibration standards (concentration, manufacturer, lot number, expiration date, etc.). All project personnel using measuring equipment or instruments in the field shall be trained in the calibration and usage of the equipment (see Section 12.0), and are personally responsible for ensuring that the equipment has been properly calibrated prior to its use.

In addition, all field instruments must undergo response verification checks at the end of the day's activities and at any other time that the user suspects or detects anomalies in the data being generated. The checks consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying a response. If an unacceptable instrument response is obtained during the check (i.e., not within specifications; see Table 3-5), the data shall be labeled suspect, the problem documented in the site logbook, and appropriate corrective action taken. See Section 13.0 for further information on corrective action procedures.

Section No.: <u>8</u>
Page: <u>2</u> of <u>4</u>
Revision No.: <u>1</u>
Date: <u>March 2000</u>

FIGURE 8-1 EQUIPMENT CALIBRATION AND MAINTENANCE FORM (TYPICAL)

Manufacture	r:		Date Purchased or Leased:					
			CA	LIBRATION LO	TTHE			
Calibration Date	Initial Settings	Standard(s) Used	Procedure	Adjustments Made	Final Settings	Signature of Operator	Comments	
			· MA	I INTENANCE LO	GSHEET	<u></u>	<u> </u>	
Maintenance Date		son for ntenance		Maintenance		Signature of Operator	Comments	
					·			
	_							

Page: 3 of 4 Revision No.: 1

Date: March 2000

To ensure the accuracy and repeatability of the geophysical survey equipment, a single geophysical test line will be acquired at the beginning and end of each day's activities with each instrument. This test line will consist of a known subsurface object or of an object placed on the ground surface (such as a steel pipe). If results along this test line for either instrument are not comparable, the instrument will be recalibrated or replaced.

The field GC instrument for the soil gas survey shall be calibrated daily prior to sample analysis. Calibration information shall be documented in the dedicated field logbook for the survey. A three to five point initial calibration must be performed to demonstrate the working range and linearity of the GC. Continuing calibrations will be run every 12 hours that the GC is in operation. If the standard responses are not within calibration limits, a new three to five point calibration curve must be generated before sample analysis can proceed.

Any equipment found to be out of calibration shall be recalibrated. When instrumentation is found to be out of calibration or damaged, an evaluation shall be made to ascertain the validity of previous test results since the last calibration check. If it is necessary to ensure the acceptability of suspect items, the originally required tests shall be repeated (if possible), using properly calibrated equipment.

Any instrument consistently found to be out of calibration shall be repaired or replaced.

8.1.2 <u>Laboratory Instrumentation</u>

Personnel at the laboratory will be responsible for ensuring that analytical instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to specific protocols/procedures.

Off-site laboratory equipment shall be calibrated using certified/nationally recognized standards and according to the applicable methodologies and the laboratory SOPs. In addition, these methods/procedures specify the appropriate operations to follow during calibration or when any instrument is found to be out of calibration. Information on and frequency for laboratory QC samples are presented in Section 9.2 and/or the specified analytical method procedures.

Section No.: 8
Page: 4 of 4
Revision No.: 1
Date: March 2000

8.2 PREVENTIVE MAINTENANCE

8.2.1 Field Instrumentation

Field equipment shall be maintained at its proper functional status in accordance to manufacturer manual specifications. A check of the equipment shall be performed before field activities begin, and any potential spare parts (e.g., batteries, connectors, etc.) and maintenance tools will be brought on site, to minimize equipment downtime during the field activities. Visual checks of the equipment will be conducted on a daily basis. Routine preventive maintenance shall be performed to assure proper operation of the equipment. Any maintenance performed on field equipment will be documented on instrument calibration and maintenance sheets or in the designated field logbook, and shall be undertaken <u>only</u> by personnel who have the appropriate skills and/or training in the type of maintenance required (see Section 12.0).

8.2.2 <u>Laboratory Instrumentation</u>

The laboratory is responsible for the maintenance of their analytical equipment, in accordance with manufacturers' specifications. Analytical personnel will be responsible for ensuring that instrumentation is functioning properly and within specific guidelines/specifications prior to starting any analysis. Maintenance, performed by either laboratory personnel or the manufacturer's service personnel, will be conducted according to manufacturer's recommendations and procedures.

Section No.: 9
Page: 1 of 10
Revision No.: 1
Date: March 2000

9.0 QUALITY ASSURANCE/QUALITY CONTROL SAMPLE REQUIREMENTS

This section will discuss the type and quantities of QA/QC samples to be utilized during implementation of the field programs. The site-specific number and type of QA/QC samples are discussed in Section 6.0.

9.1 FIELD QUALITY CONTROL SAMPLES

The subsections below present general information and guidance on field QC samples, including definition and frequency of QC blanks. Field QC samples will be labeled and shipped according to the procedures outlined in Section 5.0.

9.1.1 Field Blanks

A field blank will be collected to evaluate the potential for contamination of environmental samples from inadequate decontamination of field equipment. Field blanks shall be collected by pouring deionized (DI) water over and/or through either decontaminated equipment (e.g., split-spoons for soil sampling) or disposable equipment (e.g., disposable bailers for groundwater sampling), and collecting the rinsate (see Section 4.2 for decontamination procedures). Field blanks will be collected at a frequency of one per decontamination event per type of sampling equipment, not to exceed one per day. Preservation and analysis of field blanks will be identical to analysis of the associated environmental samples (see Table 6-2). During the groundwater sampling utilizing the low flow sampling and purging method, the field blank will be collected after sampling from the most contaminated well (as per previous data and/or location estimation). This blank will be collected by pumping DI water through the decontaminated low flow sampling apparatus and collecting the rinsate.

9.1.2 <u>Trip Blanks</u>

A trip blank serves to detect possible cross-contamination of samples resulting from handling, storage and shipment procedures. Trip blanks consist of three volatile organic analysis (VOA) vials filled with DI water and preserved accordingly (see Table 6-2), which accompany the day's aqueous environmental samples through collection and shipment to the laboratory. In addition, trip blanks are stored by the laboratory under the same conditions as the environmental samples. A trip blank will accompany each cooler containing aqueous samples for volatile organic analysis, and will be

9-1

Section No.: 9
Page: 2 of 10
Revision No.: 1
Date: March 2000

preserved as per the groundwater samples and analyzed identically to the associated environmental samples. All aqueous volatile organic samples will be consolidated in one cooler for daily shipment, as possible, to minimize the number of trip blanks required in the field program.

9.1.3 <u>Deionized Water Blanks</u>

Certificates from the supplier demonstrating that the DI water is analyte-free will be kept in the project files for each lot of DI water. A sample of the DI water used for generating the field and trip blanks will be sent for verification analysis at a rate of one per lot. The analysis will be used to confirm that any source of contamination in the field and trip blank samples is not from the DI water. DI water blanks will be collected by pouring the water directly into sample containers, and will utilize identical preservation procedures as the aqueous environmental samples. DI water blanks must be shipped separately from all other samples, and will be analyzed for the same parameters as the environmental samples.

9.1.4 <u>Temperature Blanks</u>

A temperature blank will be sent with each cooler of samples to verify that the cooler temperature has been maintained at 4°C. One VOA vial shall be filled with either potable or DI water, and labeled with "USEPA cooler temperature indicator" and the date. The laboratory shall record the temperature of the blank water on the chain of custody immediately upon cooler arrival.

9.1.5 Field Environmental Duplicate Samples

Duplicate environmental samples will be analyzed by the field GC and by the off-site laboratories to evaluate the reproducibility of the sampling procedures. Duplicate samples will be collected at a rate of five percent of the total samples for each specific matrix for each type of analysis (i.e., one duplicate for up to every 20 samples). The duplicate samples will be collected from the same location and at the same time as the original environmental sample; however, the duplicated samples will be "coded" in such a manner that the laboratory will not be able to determine of which original field sample they are duplicated (i.e., "blind" duplicates). For example, the duplicate sample of location SS01 may be "coded" as location SS11, as long as there are not more than ten surface soil locations being sampled (i.e., the coded sample name should not be assigned a legitimate sample location identification). An explanation of the duplicate "coding" must be written in the field logbook. Preservation and analysis of duplicate samples will be identical to those for the

Section No.: 9
Page: 3 of 10
Revision No.: 1

Date: <u>March 2000</u>

environmental samples. Precision of field data will be evaluated based on the calculation of Relative Percent Difference (RPD), with acceptance criteria of 50 percent for the field GC samples and 25 percent for the off-site laboratory samples.

9.2 LABORATORY QUALITY CONTROL SAMPLES

General information and guidance on laboratory QC samples are presented in the subsections below. A summary of QC procedures, frequencies, criteria, and corrective actions for the samples, as determined by the applicable method guidelines (see Section 6.0), is provided in Table 9-1.

9.2.1 Method Blanks/Preparation Blanks

A method blank, also known as a preparation blank or a laboratory reagent blank, will be analyzed with every batch of samples to ensure that contamination has not occurred during the analytical process. Method blanks consist of a portion of analyte-free water or solid that is processed through the entire sample procedure the same as an environmental sample.

9.2.2 Matrix Spikes/Matrix Spike Duplicates

Matrix spike/matrix spike duplicate samples (also known as spike/duplicate samples or laboratory fortified samples) will be used to assess precision and accuracy of the analytical methods. In this procedure, three aliquots of an actual field sample are collected at a specific location, and two aliquots are "spiked" by the addition of known amounts of an analyte or analytes and these samples are then analyzed identically to the field samples. A comparison of the resulting concentration to the original sample concentration and among the two "spiked" sample concentrations provides information on the ability of the analytical procedure to generate a correct result from the sample. Matrix spike/matrix spike duplicate samples will be collected in the field at a rate of five percent, and will be analyzed on a per batch basis, with up to 20 samples per week constituting a batch. The validity of matrix spike/matrix spike duplicate recovery and relative percent difference values will be determined using the acceptance criteria stated in Table 9-1.

9-3

Tech\RAC\comell\qapp.wpd

Section No.: 9
Page: 4 of 10
Revision No.: 1
Date: March 2000

TABLE 9-1 (Sheet 1 of 6) SUMMARY OF ANALYTICAL QC PROCEDURE CHECKS, FREQUENCIES, ACCEPTANCE CRITERIA, AND CORRECTIVE ACTIONS FOR LABORATORY SAMPLE ANALYSES

Parameter Target VOCs (soil gas)	Method Direct Measurement (Field GC)	<i>QC Procedure</i> Method Blank	Frequency 1 every 12 hours	Acceptance Criteria no constituent > CRQL	Corrective Action suspend analysis until source rectified
Low Concentration VOCs (aqueous)	OLC02.1 or latest revision	Method Blank	1 every 12 hours	no constituent > CRQL	suspend analysis until source rectified
		Surrogate Compounds	all samples	80-120%R	check calculations and instruments, reanalyze affected samples
		Internal Standards	all samples	± 40%R, ± 20 sec retention time shift	check calculations and instruments, reanalyze affected samples
		Laboratory Control Sample	1 per ≤ 20 samples	60-140%R	check calculations and instruments, reanalyze affected samples rs
TCL VOCs (solid)	OLM04.2 or latest revision	Method Blank	1 every 12 hours	no constituent > CRQL *	suspend analysis until source rectified
		Matrix Spike/Matrix Spike Duplicate	1 per ≤ 20 samples	Compound Specific (full range: 59-172%R, ± 24%RPD)	flag outliers
		Surrogate Compounds	all samples	Compound Specific (full range: 59-138%R)	check calculations and instruments, reanalyze affected samples
		Internal Standards	all samples	50-100% of area, \pm 30 sec retention time shift	check calculations and instruments, reanalyze affected samples

Section No.: 9
Page: 5 of 10
Revision No.: 1
Date: March 2000

TABLE 9-1 (Sheet 2 of 6) SUMMARY OF ANALYTICAL QC PROCEDURE CHECKS, FREQUENCIES, ACCEPTANCE CRITERIA, AND CORRECTIVE ACTIONS FOR LABORATORY SAMPLE ANALYSES

Parameter Low Concentration SVOCs (aqueous)	Method OLC02.1 or latest revision	<i>QC Procedure</i> Method Blank	Frequency 1 per ≤ 20 samples OR whenever samples extracted	Acceptance Criteria no constituent > CRQL	Corrective Action suspend analysis until source rectified
		Surrogate Compounds	all samples	Compound Specific (full range: 15-140%R)	check calculations and instruments, reanalyze affected samples
		Internal Standards	all samples	-50 to +100 % of area; ± 20 sec retention time shift	check calculations and instruments, reanalyze affected samples
		Laboratory Control Sample	1 per ≤ 20 samples	Compound Specific (full range: 10-120%R)	check calculations and instruments, reanalyze affected samples
TCL SVOCs (solid)	OLM04.2 or latest revision	Method Blank	1 per ≤ 20 samples OR whenever samples extracted	no constituent > CRQL **	suspend analysis until source rectified
		Matrix Spike/Matrix Spike Duplicate	1 per ≤ 20 samples	Compound Specific (full range: 11-142%R, ± 50%RPD)	flag outliers
		Surrogate Compounds	all samples	Compound Specific (full range: 59-138%R)	check calculations and instruments, reanalyze affected samples
		Internal Standards	all samples	-50 to +100% of area, ± 30 sec retention time shift	check calculations and instruments, reanalyze affected samples

Section No.: 9
Page: 6 of 10
Revision No.: 1
Date: March 2000

TABLE 9-1 (Sheet 3 of 6) SUMMARY OF ANALYTICAL QC PROCEDURE CHECKS, FREQUENCIES, ACCEPTANCE CRITERIA, AND CORRECTIVE ACTIONS FOR LABORATORY SAMPLE ANALYSES

<u>Parameter</u>	<u>Method</u>	QC Procedure	<u>Frequency</u>	Acceptance Criteria	Corrective Action
Low Concentration Pesticides/PCBs (aqueous)	OLC02.1 or latest revision	Method Blank	1 per ≤ 20 samples OR whenever samples extracted	no constituent > CRQL	suspend analysis until source rectified
		Surrogate Compounds	all samples	30-150%R	check calculations and instruments, reanalyze affected samples
		Laboratory Control Sample	1 per ≤ 20 samples	Compound Specific (full range: 30-150%R)	check calculations and instruments, reanalyze affected samples rs
TCL Pesticides/PCBs (solid)	OLM04.2 or latest revision	Method Blank	1 per ≤ 20 samples OR whenever samples extracted	no constituent > CRQL	suspend analysis until source rectified
		Matrix Spike/Matrix Spike Duplicate	1 per ≤ 20 samples	Compound Specific (full range: 23-139%R, ± 50%RPD)	no further action
		Surrogate Compounds	all samples	60-150%R (advisory)	no further action
PCBs Congeners (aqueous/solid)	8082 (SW846)	Method Blank	1 per ≤ 20 samples OR whenever samples extracted	no constituent > PQL	suspend analysis until source rectified
		Matrix Spike/Matrix Spike Duplicate	1 per ≤ 20 samples	lab determined (congener and matrix specific)	no further action
		Surrogate Compound	all compounds	lab determined	no further action

Section No.: 9
Page: 7 of 10
Revision No.: 1
Date: March 2000

0

TABLE 9-1 (Sheet 4 of 6) SUMMARY OF ANALYTICAL QC PROCEDURE CHECKS, FREQUENCIES, ACCEPTANCE CRITERIA, AND CORRECTIVE ACTIONS FOR LABORATORY SAMPLE ANALYSES

<u>Parameter</u>	<u>Method</u>	OC Procedure	<u>Frequency</u>	Acceptance Criteria	Corrective Action
		Internal Standard	all compounds	± 50 percent of average area	check calculations and instruments, reanalyze affected samples
TAL Inorganics (aqueous/solid)	ILM04.1 or latest revision	Preparation Blank	1 per ≤ 20 samples	no analyte > CRQL	suspend analysis until source rectified; redigest and reanalyze affected samples
		Spike/Duplicate	1 per ≤ 20 samples	75-125%R*** ± 20% RPD****	flag outliers
		Post-Digestion Spike	after any analyte (except Ag and Hg) fails spike %R	85-115%R	flag outliers
		Interference Check Sample [ICP Analysis Only]	beginning, end and periodically during run (2 times every 8 hours)	± 20% of true value****	check calculations and instruments, reanalyze affected samples
		Laboratory Control Sample	1 per ≤ 20 samples	80-120%R (except Ag and Sb) [aqueous] control limits established by USEPA [soils]	suspend analysis until source rectified; redigest and reanalyze affected samples
Geotechnical Parameters (solid)	Various	Laboratory Duplicate Sample	1 per ≤ 20 samples	± 25% RPD	reanalyze

TABLE 9-1 (Sheet 5 of 6) SUMMARY OF ANALYTICAL QC PROCEDURE CHECKS, FREQUENCIES, ACCEPTANCE CRITERIA, AND CORRECTIVE ACTIONS FOR LABORATORY SAMPLE ANALYSES

<u>Parameter</u>	<u>Method</u>	<u>OC Procedure</u>	<u>Frequency</u>	Acceptance Criteria	Corrective Action
Haloacetic Acids (aqueous)	552.2	Laboratory Reagent Blank	for each set of samples extracted or when reagents are changed	no interference peak within retention time window; no peak with concentration greater than PQL	determine source of contamination before proceding with samples
		Laboratory Fortified Matrix Spike	1 sample per extract in set	70-130% R	report data as suspect due to matrix effects (flag outliers)
		Surrogate Compounds	all samples	70-130% R	check calculations, standard solutions for degradation, contamination, and instrument performance; reanalyze extract
		Internal Standards	all samples	30% mean response OR 15% of continuing calibration standard response	optimize instrument performance and reinject affected extract
Water Quality Parameters (aqueous)	Various	Laboratory Duplicate Sample	1 per ≤ 20 samples	± 25% RPD	reanalyze
Chlorite, Bromate (aqueous)	300.1	Laboratory Reagent Blank	1 per ≤ 20 samples	no analyte > PQL	suspend analysis until source rectified
		Laboratory Fortified Blank	1 per ≤ 20 samples	85-115% R (unless MRL < 10xPQL, then 75-125%)	check calculations, suspend analysis until source rectified

AC\cornell\qapp.wpd

9-8

Section No.: 9 Page: 9 of 10 Revision No.: 1 Date: March 2000

TABLE 9-1 (Sheet 6 of 6) SUMMARY OF ANALYTICAL QC PROCEDURE CHECKS, FREQUENCIES, ACCEPTANCE CRITERIA, AND CORRECTIVE ACTIONS FOR LABORATORY SAMPLE ANALYSES

<u>Parameter</u>	<u>Method</u>	QC Procedure	<u>Frequency</u>	Acceptance Criteria	Corrective Action
×		Laboratory Fortified Sample Matrix	1 per ≤ 10 samples within analysis batch	75-125% R	quality outliers as "matrix induced bias"
		Surrogate Compounds	all samples	90-115% R	reanalyze affected samples
		Laboratory Duplicate	1 per ≤ 10 samples or 1 per analysis batch	± 20% RPD (MRL to 10x MRL); ± 10% RPD (10x MRL to highest calibration level)	qualify affected samples

Notes:

Abbreviations include:

%R = Percent Recovery

RPD = Relative Percent Difference

SVOCs = Semi-Volatile Organic Compounds

TCL = Target Compound List

MRL = Minimum Reporting Level

CRQL = Contract Required Quantitation Limit

SD = Standard Deviation

TAL = Target Analyte List

VOCs = Volatile Organic Compounds

POL = Practical Quantitation Limit

- ** with the exception of phthalates which can be up to 5 times the CRQL.
- *** with the exception when the concentration is greater than 4 times the spike concentration.
- **** with the exception when the concentration is less than 5 times the CRQL, then ± CRQL.
- **** with the exception when the instrument detection limit is greater than the CRQL for As, Pb, Se and Tl.

^{*} with the exception of methylene chloride which can be up to 2.5 times the contract required detection limit (CRQL) and acetone and 2-butanone which can be up to 5 times the CROL.

Section No.: 9
Page: 10 of 10
Revision No.: 1
Date: March 2000

9.2.3 <u>Laboratory Control Samples</u>

A laboratory control sample (LCS) consists of an analyte-free water or solid phase sample that is spiked with target analytes at a known concentration. The LCS shall be analyzed for every batch of samples (i.e., 1 per 20) to provide information on the accuracy of the analytical methods and on the laboratory's performance. The percent recoveries for the LCS compounds will be compared to QC limits stated in the appropriate methods, and are presented in Table 9-1.

9.2.4 Surrogate Compounds

Surrogates (also known as System Monitoring Compounds) are compounds added to every organic analysis sample at the beginning of the sample preparation to monitor the recovery in regard to sample preparation and analysis. Surrogate recoveries will be used to assess potential matrix interferences. The recovery values will be compared to values established in the applicable methodologies to determine the validity of the data (see Table 9-1).

9.2.5 Internal Standards

Internal standards are used to provide instrument correction for variation in instrument performance and injection volumes. Internal standards also establish relative response factors for the analytes.

9.2.6 Interference Check Samples

An interference check sample (ICS), which contains target analytes at known concentrations, verifies the laboratory's interelement and background correction factors. Analysis of ICS samples is unique to metals analysis using the inductively coupled plasma (ICP) method.

9.2.7 <u>Laboratory Duplicate Samples</u>

A laboratory duplicate sample will be prepared and analyzed for each batch of samples of similar matrix. These samples serve to demonstrate acceptable method precision (calculated through RPD values) by the laboratory.

Section No.: 10
Page: 1 of 5
Revision No.: 1
Date: March 2000

10.0 DATA REDUCTION, VALIDATION AND REPORTING

Standard methods and references will be used as guidelines for data handling, reduction, validation, and reporting. All data for the project will be compiled and summarized with an independent verification at each step in the process to prevent transcription/typographical errors. Any computerized entry of data will also undergo verification review.

10.1 DATA REDUCTION

10.1.1 Field Data Reduction

Field instrumentation data will be reported by site personnel in field logbooks and/or on field investigation forms associated with the sampling event (see Section 5.3). Soil gas survey data will be reported in a field logbook dedicated to the screening investigation. Screening data from the field GC analysis will undergo a data review, to include review of calibration, method blank and duplicate results and calculations. At the end of the field investigation, the field screening data results will be summarized in a computerized database and/or in tabulated form, as warranted.

10.1.2 Laboratory Data Reduction

The analytical laboratories will tabulate and compile analytical results and associated QA/QC information. All data generated by an off-site laboratory will be reported in a specified format containing all required elements to perform data validation (see Section 10.3.1). Analytical results shall be presented on standard USEPA Contract Laboratory Program (CLP) forms or equivalents, and include the dates the samples were received and analyzed, and the actual methodology used. Laboratory QA/QC information required by the method protocols will be compiled, including the application of data QA/QC qualifiers as appropriate. In addition, laboratory worksheets, laboratory notebooks, chains-of-custody, instrument logs, standards records, calibration records, and maintenance records, as applicable, will be provided in the laboratory data packages to determine the validity of data. Specifics on internal laboratory data reduction protocols are identified in the laboratory's SOPs.

Section No.: 10
Page: 2 of 5
Revision No.: 1
Date: March 2000

10.1.3 Project Data Reduction

Following receipt of the laboratory analytical results by Foster Wheeler Environmental, the data results will be compiled and presented in an appropriate tabular form. Where appropriate, the impacts of QA/QC qualifiers resulting from laboratory or external validation reviews will be assessed in terms of data usability.

10.1.4 Non-Direct Measurements

If information necessary for the project has not been measured directly in the field, non-direct measurement data may be obtained from literature files, texts, computer databases, etc. References utilized will be acknowledged sources within the specific discipline. An explanation of the rationale behind using the reference and a description of any concern on using the reference data (e.g., uncertainty, conflicting literature, etc.) shall be made within the report. Non-direct measurement data, after usage, will be filed within the project files for the length of the project.

10.2 DATA VALIDATION

The data results obtained from the laboratories will undergo a systematic data validation to provide assurance that the data is adequate for its intended use (i.e., in the performance of human health and ecological risk assessments and a feasibility study). The validation will be performed by personnel who have appropriate training and/or experience in performing data validation for the analyses of interest associated with the project. USEPA Region II Hazardous Waste Support Section personnel, in conjunction with the USEPA Division of Environmental Science and Assessment (DESA) personnel, will be performing data validation for all CLP RAS laboratory data. Non-RAS laboratory data will be validated by Foster Wheeler Environmental personnel.

Validation will be performed based on an evaluation of method-specific QC information (such as holding times, calibration records, laboratory and field blanks, duplicate precision, and surrogate and matrix spike recovery; see Section 9.0), the best professional judgement of the validator, and the following USEPA Region II Data Validation Standard Operating Procedures (SOPs), as appropriate:

- SOP No. HW-2: Evaluation of Metals Data for the CLP Program, Rev. 11, January 1992.
- SOP No. HW-6: CLP Organics Data Review and Preliminary Review, Rev. 11, June 1996.
- SOP No. HW-13: Organic Data Review for Low Concentration Waters, Rev. 2, October 1996.

Section No.: 10
Page: 3 of 5
Revision No.: 1
Date: March 2000

Non-conforming QA/QC results will be evaluated with respect to their implications for data reliability and usability. Qualifiers (as applicable) will be added to the data result tables by manual computer entry. All keyed entries will be verified and signed off as checked by the QA Officer or his designee.

10.3 DATA REPORTING

10.3.1 Contents of Laboratory Data Reports

The CLP RAS laboratories performing analysis work on this project will submit a hardcopy data package to the USEPA RSCC office in the appropriate CLP-required format. A copy of all validated data results for the RAS parameters will be forwarded by RSCC to Foster Wheeler Environmental.

The non-RAS hardcopy laboratory report will be sent directly to Foster Wheeler Environmental, and will contain information such as:

- Title and Location of the Project
- Project Identification Number
- Name of the Report
- Date Report was Prepared
- Name, Address and Telephone Number of the Laboratory
- Case Narrative
- Sample Identification Number
- Name and Location of Sample
- Type of Sample (e.g., water, soil)
- Analysis performed
- Parameter results
- Any special observations, circumstances or comments which may be relevant for interpretation of the data
- Signature of laboratory manager

The laboratory report will include a written case narrative, which will note any problems encountered in receipt or during analysis of the samples, and the corrective actions utilized (including telephone logs, etc.). The non-RAS data shall be reported as per the standard USEPA CLP format or equivalent. Each laboratory report will include supporting documentation, such as copies of

Section No.: 10
Page: 4 of 5
Revision No.: 1
Date: March 2000

chromatograms, data system printouts, internal sample tracking documentation, sample preparation and analysis logbooks, and standard preparation data, as appropriate. Each constituent tested will include the name of parameter, the CAS number (if applicable), approved testing procedure references, results of analysis, and the units of the reported results.

Upon receipt of a laboratory data package, the Foster Wheeler Environmental PM will maintain custody procedures, and the package shall be placed in a locked file when not undergoing processing/review. The full non-RAS data package will be sent to the RSCC for archiving approximately six months, and no later than nine months, after final data validation.

10.3.2 Contents of Management Reports

A Data Evaluation Summary Report, in the form of a Technical Memorandum, will be prepared following completion of the Phase I Investigation field activities and data evaluation. The results of the field investigation and analytical testing program will be summarized in this report, and data tables containing the laboratory results, showing all detects and non-detects, detection limits for non-detects, data qualifiers, and applicable comparison criteria, will be included. An explanation for samples where the practical quantitation limit exceeds the applicable federal/state comparison criteria will be provided. In addition, results of previous investigations will be included in the data table set. A qualitative evaluation of the usability of the data, along with justification for excluding any data if warranted, will also be provided in the report. Additional data requirements to be addressed during the Phase II Investigation will be included in the Report.

Risk Assessment Reports (human health and ecological) will be prepared under this work assignment. All usable data, as applicable and appropriate, will be included in the quantitative risk calculations. The risk assessments will determine whether Site contaminants pose a current or potential future risk to human health and the environment.

A Remedial Investigation (RI) Report will be prepared following completion of the Site investigation field activities and data evaluation. The results of the field investigation and analytical testing program will be summarized in this report, including geologic and hydrogeologic information, nature and extent of contamination, and potential fate and transport of contaminants. Comparison of the acquired Site data to existing standards and guidelines (e.g., drinking water standards and other applicable ARARs) will be performed to assist in the evaluation of the extent of contamination. The

tech\RAC\cornell\qapp.wpd 10-4 300489

Section No.: 10
Page: 5 of 5
Revision No.: 1
Date: March 2000

data will also be presented in potentiometric contour maps and in isoconcentration plume maps within the RI Report.

In addition, the Site data results will be utilized in the remedial alternatives screening during the Feasibility Study (FS). A FS Report will be prepared, which shall include detailed analyses of the potential alternatives and their cost-effectiveness.

The Foster Wheeler Environmental PM and the RAC II Quality Assurance/Data Quality Manager will review all reports, prior to submission, to ensure compliance with project requirements.

Section No.: 11
Page: 1 of 2
Revision No.: 1
Date: March 2000

11.0 PERFORMANCE AND SYSTEMS AUDITS

The Foster Wheeler Environmental PM and/or FOL will conduct a "readiness review" for field activities, prior to the commencement of the investigation. Equipment and supplies will be inventoried, and field instrumentation will be checked to ensure that all are in working order. Any maintenance activities performed during the "readiness review" are to be documented on instrument maintenance sheets or in a designated field logbook.

Internal systems and performance audits will be conducted by the off-site laboratories in accordance with USEPA analytical methodology requirements and the laboratory SOPs. The laboratories shall cooperate with USEPA or other regulatory agency personnel with Agency-requested internal technical systems and/or performance audits. In accordance with internal Foster Wheeler Environmental corporate policies, a Laboratory Audit Plan has been completed. A laboratory shall cooperate with Foster Wheeler Environmental personnel if an on-site laboratory technical systems and/or performance audit, following the Laboratory Audit Plan and performing the audit in accordance with the detailed processes and procedures specified in the RAC II Program Delivery of Analytical Services Plan (Foster Wheeler Environmental, 1998), is conducted. At present, no laboratory audits have been scheduled for this project.

Surveillance of field program activities will be conducted by the PM and FOL. In addition, in accordance with internal Foster Wheeler Environmental corporate policies, an On-site Field Audit Plan has been completed. The QA Officer and/or a member of the Foster Wheeler Environmental QA/QC staff will accompany sampling personnel into the field for one or two days, following the On-site Field Audit Plan and performing the audit in accordance with the detailed processes and procedures specified in the RAC II Program Delivery of Analytical Services Plan (Foster Wheeler Environmental, 1998), to verify that sampling is being correctly implemented according to the Work Plan, the FSP, and this QAPP. Based on the length of the field effort at the Cornell-Dubilier Site, one inspection will occur per month for the first two months of consecutive field activities, and then one inspection will be performed every six months of consecutive activities thereafter. If there is a significant time lag between phases of the field investigation program, field audits shall occur at the above schedule for each phase of the field investigation. Additional inspections may be warranted to ensure that corrective actions of major deficiencies/problems identified in an initial inspection have been implemented/addressed.

Section No.: 11
Page: 2 of 2
Revision No.: 1
Date: March 2000

Audit reports shall be generated for each audit evaluation performed (laboratory and field). The audit reports will be uniquely identified for tracking purposes, and all deficiencies noted during the audit shall be identified, with a recommended corrective action for compliance. A laboratory audit report, if generated, shall be issued to the subcontractor laboratory, with copies provided to the Foster Wheeler Environmental RAC II Program Manager, the Foster Wheeler Environmental RAC II Quality Assurance/Data Quality Manager, the Foster Wheeler Environmental PM and the USEPA QA Officer. Field audit reports shall be issued to the Foster Wheeler Environmental PM, with copies provided to the Foster Wheeler Environmental RAC II Program Manager and the Foster Wheeler Environmental RAC II Quality Assurance/Data Quality Manager. Reports shall be issued within one (1) week of audit completion, and a corrective action response due date will be identified in the cover letter of the report. The Foster Wheeler Environmental RAC II Quality Assurance/Data Quality Manager shall evaluate all audit corrective action responses and inform the Foster Wheeler Environmental PM/subcontractor organization of the closure of any or all of the deficiencies noted during the audit. A log of the audits conducted and responses thereto shall be maintained by the Quality Assurance/Data Quality Manager.

Section No.: 12
Page: 1 of 2

Revision No.: 1
Date: March 2000

12.0 TRAINING OF PROJECT STAFF

Foster Wheeler Environmental will establish requirements for training and qualification of project personnel to ensure that they are capable of performing investigation activities. The Foster Wheeler Environmental RAC II Quality Assurance/Data Quality Manager, in consultation with the Foster Wheeler Environmental PM, will establish and implement a program for the Foster Wheeler Environmental staff involved in the Cornell-Dubilier Site project to ensure compliance with the Work Plan, the FSP, the SMP, the QAPP, and the EHS Plan.

Performance-based testing will be provided to all appropriate personnel performing project activities. Foster Wheeler Environmental's performance-based testing involves the review of the personnel's work products by the Foster Wheeler Environmental PM, FOL, Quality Assurance/Data Quality Manager and/or QA Officer, until the monitored individual reaches the desired level of competence in performing his work tasks. Once a person exhibits the required degree of competence, unannounced periodic monitoring is performed to ensure this level is maintained.

12.1 GENERAL PERSONNEL TRAINING

Project staff shall receive general training on the project objectives, the DQOs for the site, the Work Plan, the FSP, the SMP, the QAPP, and the EHS Plan.

12.2 QUALITY ASSURANCE TRAINING

Training will include topics related to Quality Assurance. It will cover, but not be solely limited to:

- QAPP elements, including project-specific QA requirements
- Need for proper documentation and records maintenance
- Responsibilities of project personnel
- Handling and review of field, laboratory and non-direct measurement data
- USEPA Region II QA requirements

12.3 TECHNICAL TRAINING

Foster Wheeler Environmental will assure that all personnel performing site activities shall receive training on their respective tasks. In general, training shall be provided to accomplish:

Section No.: 12
Page: 2 of 2
Revision No.: 1
Date: March 2000

- Initial proficiency
- Maintain proficiency
- Adapt to changes in technology, methods, or job responsibilities

The extent of training will be commensurate with the following objectives:

- Scope, complexity and nature of the activity to be performed
- Prior education, experience and proficiency of personnel

12.4 TRAINING RECORDS

Foster Wheeler Environmental will complete and maintain all training records in the project files. They will include, as appropriate:

- Attendance sheets
- Records of course content, including dates of training and the instructor's name
- Training logs and curricula
- Personnel training record
- Formal qualification/certification records (as applicable)

Section No.: 13
Page: 1 of 3
Revision No.: 1
Date: March 2000

13.0 CORRECTIVE ACTION

Review and implementation of systems and procedures may result in recommendations for corrective action. Any deviations from the specified procedures within approved project plans due to unexpected site-specific conditions shall warrant corrective action. All errors, deficiencies, or other problems shall be brought to the immediate attention of the Foster Wheeler Environmental PM, who in turn shall contact the Foster Wheeler Environmental RAC II Quality Assurance/Data Quality Manager or his designee (if applicable).

Procedures have been established to ensure that conditions adverse to data quality are promptly investigated, evaluated and corrected. These procedures for review and implementation of a change are as follows:

- Define the problem.
- Investigate the cause of the problem.
- Develop a corrective action to eliminate the problem, in consultation with the personnel who defined the problem and who will implement the change.
- Complete the required form describing the change and its rationale (see below for form requirements).
- Obtain all required written approvals.
- Implement the corrective action.
- Verify that the change has eliminated the problem.

During the field investigation, all changes to the sampling program must be documented on a Field Change Request (FCR) form. A typical FCR form is shown as Figure 13-1. FCRs shall be numbered serially, starting with the number "01". A copy of the FCR must be maintained at the site and in the project management files.

If any problems occur with the laboratory or analyses, the laboratory must immediately notify CLASS (for RAS laboratories) or Foster Wheeler Environmental (for non-RAS laboratories) personnel. Consultation with appropriate personnel (e.g., the Site Chemist, the Foster Wheeler Environmental Authorized Requestor, the Foster Wheeler Environmental RAC II Quality Assurance/Data Quality Manager, the USEPA WAM, etc.) regarding appropriate actions would then follow. All approved corrective actions shall be controlled and documented.

Section No.: 13
Page: 2 of 3
Revision No.: 1
Date: March 2000

FIGURE 13-1 FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name:							
Client:		Request Number: FCR-					
Field Change Request Title:			· · · · · · · · · · · · · · · · · · ·				
To:		Location:					
Date:		- Document		<u></u>			
Description:							
Reason for Change:							
Recommended Disposition:		4 11					
Field Operations Lead (or designee)	Signature		Date				
Disposition:							
Project Manager	Signature		Date				
<u>Approval</u> :							
USEPA Work Assignment Manager	Signature		Date				
Distribution:							
USEPA WAM			eld Operations Lead				
RAC II Program Manager	Sec. N.C.	-	A Officer				
RAC II Quality Assurance/Data Qual	ity Manager		oject File				
Project Manager		O ₁	her:				

Section No.: 13
Page: 3 of 3
Revision No.: 1
Date: March 2000

All corrective action documentation (e.g., FCRs) shall include an explanation of the problem and a proposed solution. Each report must be approved by the necessary personnel (e.g., the Foster Wheeler Environmental PM, the USEPA WAM) before implementation of the change occurs. At a minimum, copies of the approved FCR form will be distributed to the USEPA WAM and to the following Foster Wheeler Environmental personnel: the RAC II Program Manager, the RAC II Quality Assurance/Data Quality Manager, the PM, the FOL, the site-specific QA Officer (as applicable), and the work assignment files. A typical distribution list is provided at the bottom of the form. The Foster Wheeler Environmental PM shall be responsible for the controlling, tracking, implementing and distributing of all identified changes/forms.

Section No.: 14
Page: 1 of 3

Revision No.: 1
Date: March 2000

14.0 REFERENCES

ASTM, 1992. Annual Book of American Society for Testing and Materials (ASTM) Standards,

Philadelphia, Pennsylvania. 1992.

Berger, 1996. Berger, Walter, Harry McCarty and Roy-Keith Smith. Environmental Laboratory

Data Evaluation. Genium Publishing Corporation, Schenectady, New York. 1996.

Federal Interagency Committee for Wetlands Delineation. 1989. Federal Manual for Identifying and

Delinating Jurisdictional Wetlands. U.S. Army Corps of Engineers, U.S. Environmental Protection

Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Conservation

Service, Washington, DC. Cooperative technical publication.

Foster Wheeler Environmental, 1995. Corporate Quality Assurance Program. February 1995.

Foster Wheeler Environmental, 1996. Corporate Scientific Procedures and Guidelines. June 1996.

Foster Wheeler Environmental, 1998. RAC II Delivery of Analytical Services Plan. July 1998.

Foster Wheeler Environmental, 1999. RAC II Quality Management Plan. July 1999, Rev. 1.

Foster Wheeler Environmental, 2000a. Work Plan for Remedial Investigation/Feasibility Study,

Cornell-Dubilier Electronics Superfund Site, South Plainfield, Middlesex County, New Jersey.

March 2000.

Foster Wheeler Environmental, 2000b. Field Sampling Plan for Remedial Investigation/Feasibility

Study, Cornell-Dubilier Electronics Superfund Site, South Plainfield, Middlesex County, New

Jersey. March 2000.

Foster Wheeler Environmental, 2000c. Site Management Plan for Remedial Investigation/

Feasibility Study, Cornell-Dubilier Electronics Superfund Site, South Plainfield, Middlesex County,

New Jersey. March 2000.

Foster Wheeler Environmental, 1999d. Environmental Health and Safety Plan for Remedial

Investigation/Feasibility Study, Cornell-Dubilier Electronics Superfund Site, South Plainfield,

14-1

Section No.: 14
Page: 2 of 3
Revision No.: 1
Date: March 2000

300499

Middlesex County, New Jersey. March 2000

MCAWW, 1983. Methods for Chemical Analysis of Water and Wastes. March 1983.

Smith, 1994. Smith, Roy-Keith. Handbook of Environmental Analysis. Second Edition. Genium Publishing Corporation, Schenectady, New York. 1994.

SW846, 1996. Test Methods for Evaluating Solid Waste Physical/Chemical. Revision 4, December 1996.

USEPA, 1992. Specification and Guidance for Obtaining Contaminant-Free Sample Containers. EPA 540/R - 93/051. OSWER Directive 9240.0-05A. December 1992.

USEPA, 1993. Data Quality Objectives Process for Superfund, Interim Final Guidance. EPA/540/R-93/071. September 1993.

USEPA, 1994. Guidance for the Data Quality Objective Process. EPA QA/G-4. EPA/600/R-96/055. September 1994.

USEPA, 1998a. EPA Guidance for Quality Assurance Project Plans. EPA/600/R-98/018. February 1998.

USEPA, 1998b. EPA Quality Manual for Environmental Programs. Order 5360. July 1998.

USEPA, 1999a. Determination of Inorganic Anions in Drinking Water by Ion Chromatography. Method 300.1, Rev. 1.0. April 1999.

USEPA, 1999b. EPA Requirements for Quality Assurance Project Plans-Interim Final. EPA QA/R-5. November 1999.

USEPA, 1995. Determination of Haloacetic Acids and Dalapon in Drinking Water by Liquid-Liquid Extraction, Derivatization and Gas Chromatography with Electron Capture Detector. Method 552.5, Rev. 1.0. 1995.

Section No.: 14
Page: 3 of 3
Revision No.: 1
Date: March 2000

USEPA Contract Laboratory Program Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration. OLM04.2.

USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration. ILM04.1.

USEPA Contract Laboratory Program Statement of Work for Organic Analysis, Low Concentration Water. OLC02.1.

Attachment 1
Non-RAS Laboratory Procurement Plan

Attachment 1 Non-RAS Laboratory Procurement Plan

The purpose of this attachment is to document procedures for the procurement of non-Routine Analytical Services (non-RAS) laboratory(ies) relating to RAC II contract sampling activities outlined in the Cornell-Dubilier Electronics Superfund (Cornell-Dubilier) Site Quality Assurance Project Plan, prepared by Foster Wheeler Environmental Corporation and approved by USEPA Region II. Please refer to the attached figure.

- Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) will prepare Laboratory Services Requests for all non-RAS parameters outlined in the USEPA Region II approved QAPP. The laboratory services request(s) will include, but is not limited to, digestion/analytical methods, data deliverable requirements, QC requirements, estimated number of samples, restrictions and penalties.
- QC limits for each parameter provided in the USEPA Region II approved QAPP will be incorporated in the analytical requests.
- Contractual policies and procedures required by the RAC II contract, and applicable Federal Acquisition Regulations (FARs) will be complied with for the procurement of subcontractors.
- The laboratory services requests will be combined with Foster Wheeler Environmental Corporation's appropriate contractual agreements in a proposal request package.
- The proposal request package will request the submittal of the laboratory service vendor's credentials, QA manuals, applicable SOPs, resumes of key personnel, description of specialties, and prior applicable Performance Evaluation (PE) results.
- The proposal request package will instruct the potential vendors to submit a proposal on all or any portion of the requested parameter analyses. The proposal request package will require submittal of unit prices for all parameters selected by the vendor for Foster Wheeler Environmental Corporation's consideration.
- The proposal request package will be approved by Foster Wheeler Environmental Corporation's RAC II Quality Assurance/Data Quality, Dr. Ming Kuo, and Program Manager, Dr. Dev Sachdev, PE.

• Potential laboratories will be solicited from the following lists:

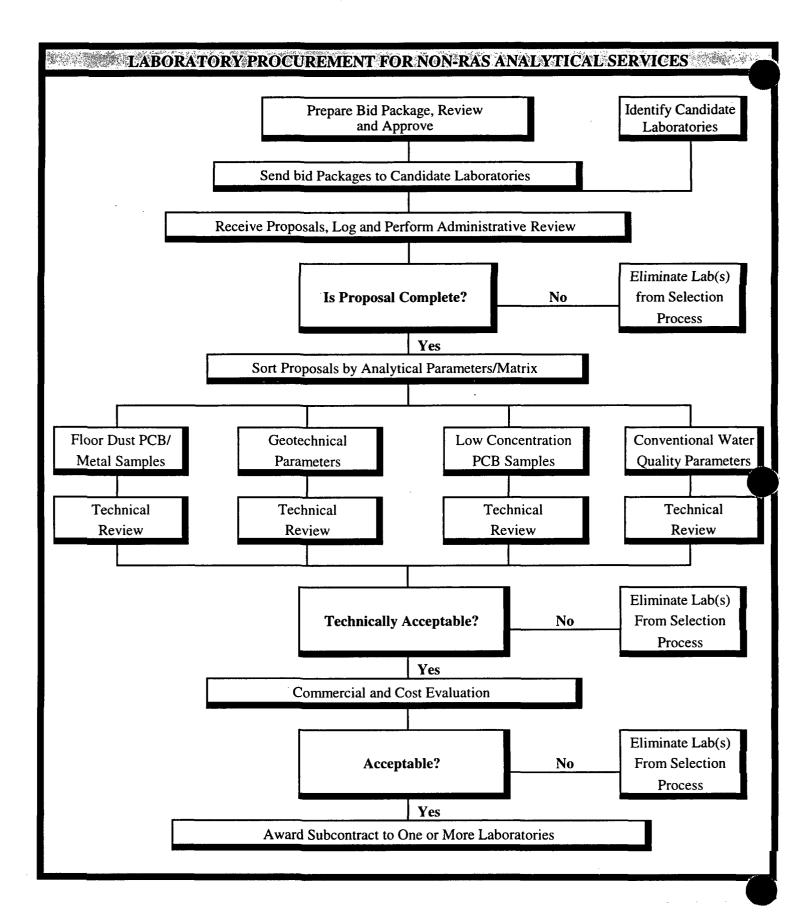
USEPA Contract Laboratory Program (CLP). CLP participants include those laboratories performing Routine Analytical Services (RAS).

Specialty Analytical Services Providers. This list includes laboratories known by Foster Wheeler Environmental Corporation for performing non-RAS analyses, such as those required for this work assignment (e.g., methanol-preserved volatile organic compounds in soil). This list will include laboratories that previously have successfully performed non-RAS analyses for Foster Wheeler Environmental Corporation.

- Proposal request packages covering all analyses will be sent to up to ten (10) candidate laboratory services vendors.
- Foster Wheeler Environmental will receive the laboratory proposals and perform an initial screening for completeness. Any incomplete laboratory proposal will be immediately rejected.
- Laboratory proposals that pass the initial screening will be sorted according to analytical parameter (as appropriate).
- Foster Wheeler Environmental will establish a review team(s) to perform a technical evaluation of the proposals. At a minimum, the review team(s) will include: (1) the Quality Assurance/Data Quality Manager or his/her designate, and (2) a scientist familiar with the specific analytical parameter being evaluated.
- Dr. Jon Gabry and Ms. Lynn Niles of Foster Wheeler Environmental will review submitted laboratory credentials, QA manuals, applicable SOPs, key personnel resumes, facilities and prior applicable PE results. Each item will be evaluated acceptable or not acceptable.
- Foster Wheeler Environmental will reject laboratory proposals that do not have sufficient credentials, acceptable QA manuals, applicable SOPs or acceptable PE results. Each laboratory vendor(s) must receive an "acceptable" evaluation on all items to be retained for further consideration.
- Dr. Jon Gabry and Ms. Lynn Niles of Foster Wheeler Environmental will perform a technical evaluation of the laboratory proposals to ensure that the required QA/QC criteria can be met.

- Foster Wheeler Environmental will reject any laboratory(ies) that are unable to meet the QA/QC criteria specified in each analytical services request (i.e., methodology, detection limits, spike recovery, etc.).
- Foster Wheeler Environmental will perform a cost evaluation for each laboratory considered capable of meeting the criteria set forth in the proposal request package.
- Based on the best value to the government, Foster Wheeler Environmental will select one or
 more laboratories to perform all of the non-RAS analytical services required for completion of
 this work assignment.
- Foster Wheeler Environmental will submit to the USEPA Contracting Officer, Project Officer, and Work Assignment Manager a recommendation(s) for subcontractor(s) with the appropriate laboratory service vendor(s). Formal Request for Consent packages will be sent only for acquisitions over \$50,000.00.
- Upon approval of Foster Wheeler Environmental's recommendation, Foster Wheeler Environmental will award a subcontract to the laboratory service vendor(s).

A1-3



PART D: ENVIRONMENTAL HEALTH AND SAFETY PLAN

ENVIRONMENTAL HEALTH AND SAFETY PLAN

Site:

Cornell-Dubilier Electronics Superfund Site

Location:

South Plainfield, New Jersey

Prepared By:

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Date Prepared:

March 2000

Version:

1

Revision:

1

Project Description: REMEDIAL INVESTIGATION/FEASIBILITY STUDY

FOSTER WHEELER ENVIRONMENTAL CORPORATION, FOSTER WHEELER SUBCONTRACTORS, AND THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, DO NOT GUARANTEE THE HEALTH OR SAFETY OF ANY PERSON ENTERING THIS SITE. DUE TO THE NATURE OF THIS SITE AND THE ACTIVITY OCCURRING THEREON, IT IS NOT POSSIBLE TO DISCOVER, EVALUATE, AND PROVIDE PROTECTION FOR ALL POSSIBLE HAZARDS WHICH MAY BE ENCOUNTERED. STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THIS SITE. THE HEALTH AND SAFETY GUIDELINES IN THIS PLAN WERE PREPARED SPECIFICALLY FOR THIS SITE AND SHOULD NOT BE USED ON ANY OTHER SITE WITHOUT PRIOR RESEARCH AND EVALUATION BY TRAINED HEALTH AND SAFETY SPECIALISTS.

APPROVALS

By their signature, the undersigned certify that this Environmental Health and Safety (EHS) Plan will be utilized for the protection of the health and safety of personnel during the Remedial Investigation/ Feasibility Study at the Cornell-Dubilier Electronics Superfund (Cornell-Dubilier) Site located in South Plainfield, New Jersey.

Project Manager

Daniel Miller, Ph.D.

3/22/2000 Date

Project Environmental and Safety Manager

Joseph L. Sbarra, CIH

03-22-00

RAC II Program Manager

Dev Sachdev, PE, Ph.D.

Date

ENVIRONMENTAL HEALTH AND SAFETY PLAN TABLE OF CONTENTS

Section No.		Page No
1.0	INT	RODUCTION
	1.1	Scope of Work
	1.2	Application
	1.3	Summary of Major Risks
2.0	PRO	JECT ORGANIZATION AND RESPONSIBILITIES 2-1
	2.1	Project Manager (PM) 2-1
	2.2	Field Operations Leader (FOL)
	2.3	Project Environmental and Safety Manager (PESM) 2-1
	2.4	Environmental and Safety Supervisor (ESS)
	2.5	Site Personnel
3.0	SITI	E LOCATION AND HISTORY 3-1
	3.1	Site Location and Description 3-1
	3.2	Site Hisory
4.0	POT	ENTIAL HAZARDS OF THE SITE 4-1
	4.1	General
	4.2	Chemical Hazards 4-1
	4.3	Physical Hazards
		4.3.1 Noise
		4.3.2 Temperature Extremes
		4.3.3 Slips, Trips, and Falls
		4.3.4 Fire and Explosion
		4.3.5 Manual Lifting
		4.3.6 Hand and Power Tool Usage
		4.3.7 Electrocution
		4.3.8 Steam, Heat, Splashing 4-4
		4.3.9 Heavy Equipment Operations (Drilling) 4-4
	4.4	Biological Hazards
		4.4.1 Animals
		4.4.2 Insects and Lyme Disease 4-4
		4.4.3 Plants
5.0	ACT	TIVITY HAZARD ANALYSES 5-1
6.0	PER	SONAL PROTECTIVE EQUIPMENT 6-1
	6.1	PPE Abbreviations 6-1
	6.2	OSHA Requirements for Personal Protective Equipment 6-3
	6.3	Respirator Cartridge Change-Out Schedule

TABLE OF CONTENTS (Cont'd)

Section No.			Page No
7.0	AIR I	MONITORING	7-1
	7.1	Real-Time Air Monitoring During Field Operations	7-1
	7.2	Data Quality Assurance	
		7.2.1 Calibration	7-1
		7.2.2 Operations	7-1
	7.3	Noise Monitoring	7-4
	7.4	Temperature Extremes Monitoring	
8.0	ZON	ES, CONTAMINATION CONTROL,	
	AND	COMMUNICATIONS	8-1
	8.1	Site Control	8-1
	8.2	Contamination Control	8-1
		8.2.1 Personnel Decontamination Station	8-1
		8.2.2 Minimization of Contact with Contaminants	8-1
		8.2.3 Personnel Decontamination Sequence	8-2
		8.2.4 Emergency Decontamination	
		8.2.5 Hand Held Equipment Decontamination	8-2
		8.2.6 Heavy Equipment Decontamination	8-3
	8.3	Communication	8-3
9.0	MED	OICAL SURVEILLANCE PROCEDURES	9-1
	9.1	Medical Surveillance Requirements	9-1
	9.2	Medical Data Sheet	9-1
10.0	SAFI	ETY CONSIDERATIONS FOR SITE OPERATIONS	10-1
	10.1	General	10-1
	10.2	Safety Considerations During Field Operations	10-1
	10.3	Sample Handling	10-1
	10.4	Drill Rigs	10-1
	10.5	Excavation and Trenching	10-1
11.0	WAS	TE MANAGEMENT PLAN	11-1
	11.1	Introduction	11-1
		11.1.1 Description	11-1
		11.1.2 Regulatory Parameters and Assumptions	11-1
	11.2	Regulatory Drivers and Guidance	
	11.3	Expected Waste Streams and Quantities	11-2
		11.3.1 Contaminants of Concern	
		11.3.2 Waste Streams and Estimated Quantities	
	11.4	Waste Management Requirements	

TABLE OF CONTENTS (Cont'd)

Section No.		Page No.
		11.4.1 Clearing Debris/Vegetative Wastes
	11.5	Waste Transporters and Disposal Approvals
	11.6	11.5.2 Disposal Facilities11-8Waste Documentation and Notification Requirements11-811.6.1 Hazardous Waste11-811.6.2 Solid Waste11-9Attachment A - NJDEP Drum Storage Area Requirements
		Attachment B - Drum Storage Area Inspection Report
12.0	EMEI	RGENCY RESPONSE PLAN 12-1
	12.1	Responsibilities
	12.2	12.1.4 Site Fersonici 12-2 Communications 12-2 12.2.1 Telephone Communications 12-2 12.2.2 Air Horns 12-2 12.2.3 Hand Signals 12-2
	12.3	Pre-Emergency Planning
	12.4	Emergency Medical Treatment
	12.5	Emergency Site Evacuation Routes and Procedures 12-3
	12.6	Fire Prevention and Protection
	12.7	Overt Chemical Exposure
	12.8	Decontamination During Medical Emergencies 12-6
	12.9	Accident/Incident Reporting
	12.10	Adverse Weather Conditions
	12.11	Spill Control and Response
	12.12	Emergency Equipment
	12.13	
	12.14	Restoration and Salvage
13.0	TRAI	NING REQUIREMENTS
	13.1	Site-Specific Training
	13.2	General Health and Safety Training (40 Hour OSHA Training) 13-1
	13.3	Annual Eight-Hour Refresher Training

TABLE OF CONTENTS (Cont'd)

Section No.			Page No.
	13.4	On-Site Safety Briefings	13-1
	13.5	First Aid and CPR	
	13.6	Hazard Communication	13-1
14.0	LOG	S, REPORTS AND RECORDKEEPING	14-1
	14.1	Field Change Request	14-1
	14.2	On-Site Log	
	14.3	Health and Safety Reports	
	14.4	Accident/Incident Reports	
	14.5	Material Safety Data Sheets	
15.0	FIEL	D PERSONNEL REVIEW	15-1
		LIST OF TABLES	
Table 4-1	Chemi	cal Data	4-2
Table 6-1	Person	al Protective Equipment Selection	6-2
Table 7-1	Freque	ency and Location of Air Monitoring	7-2
Table 7-2	Real-T	ime Air Monitoring Action Levels	7-3
Table 11-1	Small	Quantity Hazardous Waste Generator Requirements	11-4
Table 11-2	TSCA	PCB Requirements	11-6
Table 11-3	NJDE	P Solid Waste Generator Requirements	11-7
Table 12-1	Emerg	ency Telephone Numbers	12-4
		LIST OF APPENDICES	
Appendix A	Field	Change Request Form	
Appendix B		ical Data Sheets	
Appendix C	Hospi	tal Route Map and Directions	
Appendix D	-	ity Hazard Analyses	
Appendix E	EHS I		
Appendix F	Temp	erature Extremes Program, Drill Rig Safety Program, Excavation	and
* *	-	hing Program	

1.0 INTRODUCTION

This Environmental Health and Safety Plan (EHS Plan) has been prepared in conformance with Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) Health and Safety Plan guidelines, applicable OSHA regulations, and project requirements. It addresses those activities associated with the reconnaissance and Phase I RI/FS activities at the Cornell-Dubilier Electronics Superfund Site in South Plainfield, Middlesex County, New Jersey. The Field Operations Leader (FOL) will implement this plan during site work. Compliance with this EHS Plan is required of all persons and third parties that perform fieldwork for this project.

Assistance in implementing this EHS Plan can be obtained from the Foster Wheeler Environmental Corporation Project Environmental and Safety Manager (PESM). The contents of this EHS Plan may change or undergo revision based upon additional information made available to health and safety personnel, monitoring results, or changes in the technical scope of the work. Any changes proposed must be reviewed by the Project Manager (PM) and are subject to approval of the PESM. The Field Change Request Form provided in Appendix A may be used to initiate such changes.

Refusal or failure to comply with the EHS Plan or violation of any safety procedures by field personnel and/or subcontractors may result in immediate removal from the site following consultation with the PESM and the PM.

1.1 Scope of Work

The EHS Plan addresses the following activities:

- Site Mobilization/Demobilization
- Drilling Operations
 - Well installation
 - Hydraulic testing
 - Soil borings
- Excavation of Test Pits
- Environmental Sampling
 - Groundwater
 - On- and Off-site Surface Soil
 - Surface Water and Sediment
 - Building, Debris, and/or Wipe Samples
- Wetlands Survey
- Dye Testing to locate drains
- Geophysical Survey (magnetometer, electromagnetic)
- IDW Characterization and Disposal
- Decontamination (Steam Cleaning)

1.2 Application

This EHS Plan applies to all personnel involved in the above tasks who wish to gain access to active work areas, including but not limited to:

- Client representatives
- Federal, state or local representatives
- Foster Wheeler Environmental employees and subcontractors

1.3 Summary of Major Risks

- Exposure to site contaminants
- Biological hazards
- Slips, trips and falls

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section specifies the Foster Wheeler Environmental Project Organization and responsibilities.

2.1 Project Manager (PM)

......

The PM is Daniel Miller; his responsibilities include the following:

- Ensures implementation of this program through coordination with the responsible Project Environmental and Safety Manager (PESM);
- Participates in major incident investigations;
- Ensures the EHS Plan has all of the required approvals before any Site work is conducted;
- Ensure that the PESM or Site Environmental and Safety Supervisor (ESS) is informed of project changes which require modifications of the site safety plan; and,
- Has overall project responsibility for Project Health and Safety.

2.2 Field Operations Leader (FOL)

The FOL is Lynn Niles; her responsibilities include the following:

- Ensures that the EHS Plan is implemented in conjunction with the designated PESM and ESS:
- Ensures that field work is scheduled with adequate personnel and equipment resources to complete the job safely;
- Ensures that adequate communication between field crews and emergency response personnel is maintained;
- Ensures that field site personnel are adequately trained and qualified to work at the site;
- Enforces site health and safety rules;
- Investigates major incidents;
- Conducts daily safety briefings;
- Conducts periodic site inspections; and
- Acts as Emergency Coordinator.

2.3 Project Environmental and Safety Manager (PESM)

The PESM is Joseph L. Sbarra, CIH; His responsibilities include the following:

- Provides for the development and approval of the EHS Plan;
- Serves as the primary contact to review health and safety matters that may arise;
- Conducts quarterly inspections at the project to ensure compliance with the EHS Plan and corporate requirements;
- Approves revised or new safety protocols for field operations;
- Approves individuals who are assigned ESS responsibilities;
- Approves ESSs to fulfill other project roles;
- Coordinates revisions of this EHS Plan with field personnel;

- Coordinates upgrading or downgrading of personal protective equipment with the FOL/ESS; and
- Assists in the investigation of major accidents.

2.4 Environmental and Safety Supervisor (ESS)

The ESS is John Lane. The ESS is a person knowledgeable in appropriate health and safety regulations with at least one year of experience or specialized training in serving in a health and safety staff role on hazardous waste sites. Ms. Tiffany Sollog is designated as the alternate ESS, in the event that Mr. Lane cannot serve in that capacity. His/her responsibilities include:

- Works as a member of the project team to ensure implementation of the EHS Plan;
- Ensures that all health and safety activities identified in site safety plans are conducted and/or implemented;
- Identifies operational changes which require modifications to health and safety procedures and site safety plans, and ensures that the procedure modifications are implemented and documented through changes to the EHS Plan;
- Directs and coordinates health and safety monitoring activities;
- Ensures that proper personal protective equipment is utilized by field teams;
- Ensures compliance with decontamination procedures;
- Assists in conducting and documenting daily safety briefings;
- Monitors compliance with this EHS Plan;
- Notifies PESM of all accidents/incidents;
- Coordinates with the Field Operations Leader and PM in any accident/incident investigation;
- Maintains Accident/Incident Report Forms;
- Determines upgrades or downgrades of personal protective equipment (PPE) based on site conditions and/or real-time monitoring results;
- Ensures that monitoring instruments are calibrated;
- Reports to PESM to provide summaries of field operations and progress; and
- Maintains health and safety field log books.

2.5 Site Personnel

Report any unsafe or potentially hazardous conditions to the FOL/ESS;

- Maintain knowledge of the information, instructions and emergency response actions contained in the EHS Plan;
- Comply with rules, regulations and procedures as set forth in this EHS Plan and any revisions:
- Prevent admittance to work sites by unauthorized personnel; and,
- Inspect all tools and equipment, including PPE, daily prior to use.

3.0 SITE LOCATION AND HISTORY

3.1 Site Location and Description

The Cornell-Dubilier Site is a 25-acre site located at 333 Hamilton Boulevard, in South Plainfield, Middlesex County, New Jersey. The Hamilton Industrial Park, which consists of approximately 15 small industries, currently occupies the Site property. The Site is bordered by Bound Brook and railway tracks to the northeast, Hamilton Boulevard and residential and commercial properties to the northwest, the South Plainfield Department of Public Works property to the southeast, and Spicer Avenue and residential properties to the southwest. A Site Location Map is provided as Figure 1-1 in the Work Plan, and a Site Plan is presented in Figure 1-2 in the Work Plan.

3.2 Site History

The following presents an overview of the Cornell-Dubilier Site history. Additional, more detailed information is presented in Section 1.2 of the Work Plan.

From 1936 to 1962, Cornell-Dubilier Electronics, Inc. manufactured electronic components, including capacitors, on the Site property. Allegedly, during its operations, the company disposed of transformer oil and other materials contaminated with polychlorinated biphenyls (PCBs) directly onto Site soils. Residual wastes from the on-site processes may also have been landfilled on the Site property, including trichloroethene (TCE), which was used during operations as a degreasing agent.

Personnel from the New Jersey Department of Environmental Protection (NJDEP) visited the Site on March 12, 1985, and noted that an area in the rear of the facility contained black soil. In addition, four large black tanks were present on the edge of a large filled-in area, situated in the rear of the Site. These tanks were at the top of the embankment leading down to Bound Brook.

On September 11, 1986, NJDEP conducted a Site inspection and collected soil, surface water, and sediment samples at the Site. Metals, volatile organic compounds (VOCs) and PCBs were detected in the soil and sediment samples.

The United States Environmental Protection Agency (USEPA) collected surface soil, sediment, and surface water samples from the Site on June 8, 1994. PCBs and various metals were detected at elevated concentrations in the soils. A sediment sample from the stream near the rear of the property contained Aroclor-1254, 1,2-dichloroethene, trichloroethene, and lead. Aroclor-1254, 1,2-dichloroethene, trichloroethene, and lead were also detected in surface water samples, along with Aroclor-1248 and other heavy metals.

A screening-level ecological risk assessment was performed by USEPA in June 1996. The assessment indicated that contamination of stream sediments adjacent to the Site, and apparently associated with the Site, were present at levels which have been linked to adverse impacts in benthic organisms.

On June 27 and 29, 1996, USEPA collected additional surface and subsurface soil samples from a roadway, a vacant field, and a foot/bike path on the Site. Surface soil samples contained Aroclor-1254 up to 51,000 mg/kg, and the sample with the maximum concentration was collected near the northeast corner of the fenced area, where electrical and transformer parts were exposed in a swale. Aroclor-1254 was also detected on the surface of the roadway (maximum value: 340 mg/kg) and along the foot/bike path (maximum value: 3,000 mg/kg). In addition, the more elevated concentrations of lead and cadmium were noted in the northeast corner of the fenced area and near the foot/bike path.

Test pits were excavated in the vacant field during July 1996. The test pits revealed stained soils, drum carcasses, electrical parts, mica-like chips, wood, and other debris. Aroclor-1254 and lead were detected in test pit soil samples.

On March 25, 1997, a unilateral administrative order was issued to the owner of the industrial park, which required the paving of facility driveways and parking areas, the installation of security and silt fencing to reduce migration of contaminants, and the posting of warning signs.

In March and June 1997, USEPA conducted building interior sampling (wipe, chip and vacuum) at the Site. Aroclor-1248, Aroclor-1254 and/or weathered Aroclor-1260 were detected in the samples, along with lead and cadmium.

USEPA collected additional samples in June and August 1997, including soil, sediment, water and biota samples. PCBs and four metals were detected in the sediment and flood plain soils. Fish tissue samples contained two PCBs and seven pesticides. NJDEP issued an interim fish consumption advisory for Bound Brook and New Market Pond on August 9, 1997.

In October and November 1997, USEPA collected soil and dust samples, respectively, at nearby residential properties (referred to as Tier I). Additional soil sampling activities were conducted in April 1998 (referred to as Tier II) and May 1998 (referred to as Tier III). The interiors of seven Tier I residences, where PCBs were present at levels of potential health concern, were cleaned in April 1998, and sampling of residential interiors were also performed at 36 residences from April 21 through 28, 1998. On November 14, 1998, surface soil samples were again collected from one of the properties along Spicer Avenue (referred to as Addendum to Tier I). Elevated levels of PCBs were noted in soils and dust at several residences located near the Site.

The Cornell-Dubilier Electronics Superfund Site was listed on the federal National Priorities List (NPL) of hazardous waste sites on July 28, 1998.

In August 1998, Cornell-Dubilier Electronics and D.S.C. of Newark, Inc. (the current property owner) entered into an Administrative Consent Order for a removal action which includes removal and disposal of contaminated soil from five residential properties and the delineation of contamination at a sixth. In March 1999, USEPA ordered Cornell-Dubilier Electronics and D.S.C. of Newark, Inc. to conduct a removal action at seven additional residential properties.

4.0 POTENTIAL HAZARDS OF THE SITE

4.1 General

This section presents an assessment of the chemical, physical, and biological hazards that may be encountered during the tasks specified under Section 1.1.

4.2 Chemical Hazards

The primary contaminants of concern for work to be performed at the Cornell-Dubilier Site are polychlorinated biphenyls, lead, coal tar pitch volatiles and trichloroethylene.

Polychlorinated biphenyls (PCBs) are solids or liquids and contain varying concentrations of chlorine. They have very low vapor pressures and are not expected to volatilize under Site conditions. The maximum concentration of Aroclor-1248 (21,000 mg/kg) was detected in the building chip. The maximum concentration of Aroclor-1254 (51,000 mg/kg) was detected in the surface soil at the northeast corner of the fenced area where electrical components are exposed. Aroclor-1248 and -1254 are considered area-specific contaminants. Skin contact is a main route of exposure and can cause chloracne and systemic effects. The PCBs may also adhere to dust particles and be inhaled if there is an excessive amount of dust.

Review of historical information of this area indicates that the sediment is contaminated with coal tar pitch volatiles (CTPV) such as fluoranthene and chrysene. Fluoranthene was detected at a maximum concentration of 5 mg/kg in soil; chrysene was detected at a maximum concentration of 5.1 mg/kg in sediment. These compounds may present an occupational exposure hazard during Site operations, particularly at low tide and when personnel are walking on the surface during surveying operations.

Trichloroethylene (TCE), a volatile organic compound, is present in the sediment and surface water. TCE was detected at a maximum concentration of 2 ug/L in surface water and 120 ug/kg in sediment. TCE is not anticipated to be an occupational health hazard due to the low concentrations detected on-site. However, it will be considered as a potential contaminant of concern in groundwater since it was detected at a maximum concentration of 6,850 ug/L in private supply wells to the south and west of the Site. This compound generally has a depressant effect on the central nervous system, may cause chronic liver and kidney damage, and is a suspected human carcinogen. Acute exposure may include headache, dizziness, nausea, and skin and eye irritation.

Lead is present in the surface soil at a maximum concentration of 66,600 mg/kg. Lead is known to irritate the eyes and cause abdominal pain, colic, anemia, weakness, insomnia, constipation, hypotension, facial pallor, weight loss, paralysis of wrists and ankles, kidney disease, and a gingival lead line.

Chemical Data information can be found in Table 4-1 and on the Chemical Data Sheets, found in Appendix B. In addition to the chemical hazards possibly existing at the Site, additional chemical hazards may be present due to materials being brought to the site, such as acids/organic compounds, and decontamination fluids. Prior to working with these materials on-site, Material Safety Data

TABLE 4-1 CHEMICAL DATA

COMPOUND	CAS#	ACGIH TLV	OSHA PEL	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Chlorodiphenyl (PCBs), (Aroclor-1254)	11097-69-1	0.5 mg/m³ Skin	0.5 mg/m³ Skin	Inhalation, Skin Contact, Skin Absorption, Ingestion	Irritates eyes; chloracne; liver damage; reproductive effects	Skin, eyes, liver, reproductive system	Colorless to pale yellow, viscous liquid or solid with a mild, hydrocarbon odor
Coal Tar Pitch Volatiles (CTPV)	65996-93-2	0.2 mg/m ³	0.2 mg/m ³	Inhalation, Skin Contact	Dermatitis; bronchitis, known human carcinogen (lungs, kidneys, skin)	Respiratory system, skin, kidneys, bladder	Black or dark brown amorphous residue
Lead	7439-92-1	0.05 mg/m ³	0.05 mg/m ³	Inhalation, Skin Contact,, Ingestion	Irritates eyes, abdominal pain, colic, anemia, weakness, insomnia, constipation, hypotension, facial pallor, weight loss, paralysis of wrists and ankles, kidney disease, gingival lead line	Eyes, GI tract, CNS, kidneys, blood, gingival tissue	Heavy, ductile, soft gray solid
Trichloro- ethylene	79-01-6	50 ppm TWA, 100 ppm STEL	100 ppm, TWA, 200 ppm ceiling	Inhalation, Skin Absorption, Skin Contact, Ingestion	Irritates eyes, skin; headache, vertigo, visual distortion, fatigue, giddiness; tremors, nausea, vomiting; dermatitis, cardiac arrhythmia, paresthesia	Skin, eyes, liver, CNS, heart, respiratory system	Colorless liquid with a chloroform like odor, IP= 9.45 eV VP= 58 mm

Abbreviations
C = ceiling limit, not to be exceeded

CNS = Central Nervous System

CVS = Cardiovascular System

eV = electron volt

FP = Flash point

IP = Ionization Potential

GI = Gastrointestinal

LEL = Lower explosive limit

mm = millimeter

ppm = parts per million

Skin = significant route of exposure

STEL = Short-term exposure limit (15 minutes)

TWA = Time-weighted average (8 hours)

UEL = Upper explosive limit

VP = vapor pressure approximately 68° F in mm Hg (mercury)

Sheets (MSDSs) will be obtained and reviewed by all potentially affected personnel. A copy of all MSDSs will be located in a binder in the main trailer at the Site.

4.3 Physical Hazards

A variety of physical hazards may be present during Site activities. The most common hazards are struck by/against hazards during sampling; slips, trips, falls and cold stress. Other physical hazards are due to the use of hand and power tools, and material handling. These hazards are not unique and are generally familiar to hazardous waste workers. Additional specific safety requirements may be covered during safety briefings at the Site.

4.3.1 Noise

Noise is a potential hazard associated with the operation of heavy equipment, drill rigs, power tools, pumps and generators. Excessive noise presents two potential problems at the site. First, it hinders communication between workers. Second, excessive noise exposures (to both continuous and impact noise) can have adverse effects on a person's hearing. These adverse effects include both temporary and permanent hearing damage.

4.3.2 Temperature Extremes

Heat Stress

Heat stress is a significant potential hazard, which is greatly exacerbated with the use of PPE, in hot environments. The potential hazards of working in hot environments include dehydration, cramps, heat rash, heat exhaustion, and heat stroke.

Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia as well as slippery surfaces, brittle equipment, poor judgment and unauthorized procedural changes.

4.3.3 Slips, Trips, and Falls

Working in and around the Site will pose slip, trip, and fall hazards due to uneven terrain, slippery surfaces that may be oil covered, or from surfaces that are icy or wet from rain. Potential adverse health effects include falling to the ground and becoming injured or twisting an ankle.

4.3.4 Fire and Explosion

When conducting excavation and drilling activities, the opportunity of encountering fire and explosion hazards exists from underground gases and utilities. Additionally, the use of generators, power tools, and the diesel engine on the drill rig, could present the possibility of encountering fire and explosion hazards.

4.3.5 Manual Lifting

Manual lifting of heavy objects may be required. Failure to follow proper lifting technique can result in back injuries and strains. Back injuries are a serious concern as they are the most common workplace injury, often resulting in lost or restricted work time, and long treatment and recovery periods.

4.3.6 Hand and Power Tool Usage

In order to complete the various tasks for the project, personnel will utilize hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution.

4.3.7 Electrocution

The use of power tools and extension cords may pose electrical hazards to workers. Additionally, overhead electrical lines can be a concern during excavation and drilling operations. Potential adverse effects of electrical hazards include shocks, burns, and electrocution, which could result in death.

4.3.8 Steam, Heat, Splashing

Exposure to steam/heat/splashing hazards can occur during steam cleaning activities. Splashing can also occur during the wetlands survey, dye testing, and groundwater well development and sampling. Exposure to steam/heat/splashing can result in scalding/burns, eye injury, and puncture wounds.

4.3.9 Heavy Equipment Operations (Drilling)

A backhoe will be used to dig test pits. In order to install wells and soil borings, a drill rig will be used. Working with or near heavy equipment poses many potential hazards, including electrocution, fire/explosion, being struck by or against, or pinched/caught/crushed by, and can result in serious physical harm.

4.4 Biological Hazards

During the course of the project, there is low potential for workers to come into contact with biological hazards such as animals, insects and plants since the Site is partially paved and is in an industrial setting.

4.4.1 Animals

During Site operations, animals such as dogs, cats, raccoons, skunks, mice and snakes may be encountered. Workers shall use discretion and avoid all contact with animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed control technician.

4.4.2 Insects and Lyme Disease

Insects, such as mosquitoes, ticks, bees and wasps may be present during certain times of the year. Workers will be encouraged to wear repellents (DEET for Ticks) when working in areas where

tech\RAC\Cornell-Dub\EHS.wpd 4-4 300523

insects are expected to be present. If insects are prevalent, efforts will be made to remove them from the Site by contacting a licensed pest control technician.

Since the Site is located in the northeast, the potential for coming into contact with deer ticks exists. Lyme disease is caused by an infection from a deer tick which is about the size of the head of a pin. During the painless tick bite, a microorganism (spirochete) may be transmitted into the bloodstream, which may lead to Lyme disease. The effects of the disease vary from person to person, which often makes it difficult to diagnose. Typically, the incubation period ranges from two days to two weeks. In most cases, the infected area will resemble a red bulls' eye with concentric rings. Within the same period, flu-like symptoms may develop. If left untreated, the red ringed area will eventually fade and Lyme disease may further develop into an arthritis-like condition.

Control measures to prevent Lyme disease include the following:

- Self/Buddy check of neck, hairline, groin and body after working in areas that may contain deer ticks:
- Wear light colored Tyvek or clothing;
- If a tick is found, remove it by pulling gently at the head with tweezers; and
- Report any of the above symptoms and all tick bites to the ESS for evaluation. Employees bitten by deer ticks during the course of employment will have a medical examination made available to them.

4.4.3 Plants

The potential for contact with poisonous plants exists when performing field work in undeveloped and wooded areas. Poison ivy, sumac, and oak may be present on-site.

Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring.

Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves, which are velvety dark green on top and pale underneath. The branches of immature trees have a velvety "down." Poison sumac has white, "hairy" berry clusters.

Poison oak can be present as a sparingly branched shrub. Poison oak is similar to poison ivy in that it has the same leaflet configuration, however, the leaves have slightly deeper notches.

Contact with poison ivy, sumac, or oak may lead to a skin rash, characterized by reddened, itchy, blistering skin which needs first aid treatment. If you believe you have contacted one of these plants, notify the ESS and immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.

5.0 ACTIVITY HAZARD ANALYSES

The Activity Hazard Analysis (AHA) is a systematic way of identifying the potential health and safety hazards associated with major phases of work on the project and the methods to avoid, control and mitigate those hazards. AHAs are developed for all activities as necessary, prior to start-up. The AHAs will be used to train work crews in proper safety procedures during phase preparatory meetings.

AHAs are included in Appendix D of this EHS Plan. AHAs have been developed for the following phases of work:

- Site Mobilization/Demobilization
- Drilling Operations
- Excavation Operations
- Groundwater Sampling
- Surface Soil Sampling
- Surface Water and Sediment Sampling
- Building, Debris, and/or Wipe Samples
- Decontamination
- Dye Testing
- Geophysical Survey
- IDW Characterization and Disposal
- Wetlands Survey

6.0 PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment (PPE) specified in Table 6-1 represents the hazard analysis and PPE selection required by 29 CFR 1910.132. Specific information on the selection rationale for each activity can be found under Section 4.0 and Appendix D for Activity Hazard Analyses. For the purposes of PPE selection, the PESM and ESS are considered competent persons. The signatures on the approval page constitute certification of the hazard assessment. For activities not covered by Table 6-1, the PESM or ESS will conduct the hazard assessment and select the PPE using the form provided in Appendix E and shall certify the assessment by signing the form.

Modifications for initial PPE selection may also be made by the ESS in consultation with the PESM. A written justification for downgrades will be provided to the PESM for approval as a field change request.

6.1 PPE Abbreviations

HEAD PROTECTION	EYE/FACE PROTECTION	FOOT PROTECTION
HH = Hard Hat	APR = Full Face Air Purifying	Neo = Neoprene
·	Respirator	OB = Overboot
HEARING PROTECTION	GOG = Goggles	Poly = polyethylene coated boot
EP = ear plugs	MFS = Mesh Face shield	Rub = rubber slush boots
EM = ear muffs	PFS = Plastic Face shield	STB = Leather work boots with
	SG = ANSI approved safety	steel toe.
	glasses with side shields	

BODY PROTECTION
WC = Work clothes
Cot Cov = Cotton Coveralls
Poly = Polyethylene coated
tyvek coveralls
Saran = Saranex coated tyvel
coveralls

Saran = Saranex coated tyvek coveralls Tyvek = Uncoated paper tyvek coveralls RESPIRATORY PROTECTION
Level C = Full face air purifying

respirator with approved cartridges
Level B = Full face air supplied
respirator with escape bottle

Table 6-1 summarizes the PPE required for each task.

TABLE 6-1
PERSONAL PROTECTIVE EQUIPMENT SELECTION

TASK	HEAD	EYE	FEET	HANDS	BODY	HEARING	RESPIRATOR
Mobilization/	НН	SG	STB	LWG	WC	None	None
Demobilization							
Drilling Operations	НН	SG	STB/OB	WG	WC, tyvek as needed	EP or EM	None
Hydraulic (Pump) Testing	НН	SG, GOG as needed	STB	WG or NIT	WC	None	None
Groundwater Sampling	НН	SG	STB	Sur + Nit	WC	None	None
Surface Soil Sampling	HH	SG	STB/OB	Sur + Nit	WC	EP or EM	None
Surface Water and Sediment Sampling	НН	SG	STB/OB or waders	Sur	WC, tyvek as needed	None	None
Building, Debris, and/or Wipe Samples	НН	SG, GOG for concrete cutting	STB/OB	Sur + Nit	WC	EP or EM as needed	None
IDW Characterization and Disposal	НН	SG	STB	Sur + Nit	WC, tyvek as needed	None	None
Decontamination	НН	GOG + PFS	STB + OB or Rub	Sur + Nit	WC + chest waders or Poly	EP or EM	Level C
Wetlands Survey	НН	SG, GOG as needed	STB/OB or waders as needed	WG, Sur as needed	WC	None	None
Dye Testing	НН	SG	STB	Sur	WC	None	None
Excavation Operations	НН	SG	STB	Wg, Nit for sampling	WC	EP or EM	None
Geotechnical Survey	НН	SG	Sturdy work boots	LWG	WC .	None	None

6.2 OSHA Requirements for Personal Protective Equipment

All personal protective equipment used during the course of this field activity must meet the following OSHA standards:

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1
Respiratory	29 CFR 1910.134	ANSI Z88.1
Head	29 CFR 1910.135	ANSI Z89.1
Foot	29 CFR 1910.136	ANSI Z41.1

ANSI = American National Standards Institute

Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.1025; 29 CFR 1910 134). Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency;
- IDLH concentrations; and
- If contaminant levels exceed designated use concentrations.

6.3 Respirator Cartridge Change-Out Schedule

A respirator cartridge change-out schedule has been developed in order to comply with 29 CFR 1910.134. The respirator cartridge change-out schedule for this project is as follows:

- Cartridges shall be removed and disposed of at the end of each shift, when cartridges become wet or wearer experiences breakthrough, whichever occurs first; and
- If the humidity exceeds 85%, then cartridges shall be removed and disposed of after 4 hours of use, if average FID readings exceed 10 ppm.

Respirators shall not be stored at the end of the shift with contaminated cartridges left on. Cartridges shall not be worn on the second day, no matter how short of time period they were used the day before.

The schedule was developed based on the following scientific information and assumptions:

- Analytical data that is available regarding Site contaminants;
- Using the Rule of Thumb provided by the AIHA;
- TCE has a boiling point greater than 70° C;
- Total airborne concentration of contaminants is anticipated to be less than 100 ppm;
- The humidity is expected to be less than 85%; and
- Desorption of the contaminants (including those with poor warning properties) after partial use of the chemical cartridge can occur after a short period (hours) without use (e g, overnight) and result in a non-use exposure.

The following is a partial list of factors that may affect the usable cartridge service life and/or the degree of respiratory protection attainable under actual workplace conditions. These factors have been considered when developing the cartridge change-out schedule.

- Type of contaminant(s)
- Contaminant concentration
- Relative humidity
- Breathing rate
- Temperature
- Changes in contaminant concentration, humidity, breathing rate and temperature
- Mixtures of contaminants
- Accuracy in the determination of the conditions
- The contaminant concentration in the workplace can vary greatly. Consideration must be given to the quality of the estimate of the workplace concentration
- Storage conditions between multiple uses of the same respirator cartridges. It is recommended that the chemical cartridges be replaced after each work shift. Contaminants adsorbed on a cartridge can migrate through the carbon bed without airflow.
- Age of the cartridge
- Condition of the cartridge and respirator
- Respirator and cartridge selection Respirator fit
- Respirator assembly, operation, and maintenance
- User training, experience and medical fitness
- Warning properties of the contaminant
- The quality of the warning properties should be considered when establishing the chemical cartridge change schedule. Good warning properties may provide a secondary or back-up indication for cartridge change-out.

7.0 AIR MONITORING

7.1 Real-Time Air Monitoring During Field Operations

Table 7-1 presents a breakdown of each main activity where monitoring will be required and provides the instrumentation, frequency and location of the real-time monitoring for the site. Note: Not all activities will require real-time monitoring. Table 7-2 lists the Real-Time Air Monitoring Action Levels to be used in all work areas.

The following instruments will be used for monitoring during fieldwork:

- Flame Ionization Detector (FID) (Photovac MicroFID or equivalent); or
- Photoionization Detector (PID) (Photovac MicroTIP or equivalent).
- Combustible Gas Indicator (CGI) with Oxygen (O₂) sensor (MSA Passport or equivalent): and
- Dust Meter (MIE PDM-3 or equivalent).

7.2 Data Quality Assurance

7.2.1 Calibration

Instrument calibration shall be documented and included in a dedicated safety and health logbook or on separate calibration pages. All instruments shall be calibrated before and after each shift. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

7.2.2 Operations

All instruments shall be operated in accordance with the manufacturer's specifications. Manufacturers' literature, including an operations manual for each piece of monitoring equipment will be maintained on-site by the ESS for reference.

300531

TABLE 7-1 FREQUENCY AND LOCATION OF AIR MONITORING

ACTIVITY	AIR MONITORING INSTRUMENT	FREQUENCY AND LOCATION
Test Pit, Drilling Activities and Soil Gas Survey	PID/FID	Continuous in BZ during intrusive activities, screening in the BZ every 30 minutes during non-intrusive activities
NOTE: Drilling activities include well drilling, and split-spoon sampling.		
Test Pit and Drilling Activities	CGI	Screening in the hole and work area every 15 minutes
Test Pit Activities and Concrete Core Cutting (During Building Borings)	Dust Meter	In work area every 15 minutes during intrusive activities
Groundwater Monitoring, Building Borings/Water/ Sediment, and Surface Soil Sampling (on-site)	FID	Initial screening in BZ, and screening in the BZ every 30 minutes thereafter

TABLE 7-2
REAL-TIME AIR MONITORING ACTION LEVELS

AIR MONITORING INSTRUMENT	MONITORING LOCATION	ACTION LEVEL	SITE ACTION	REASON
PID/FID	Breathing Zone	1 - 10 ppm above background	No respiratory protection	Levels below exposure limits for TCE
PID/FID	Breathing Zone	10 - 100 ppm	Level C Respirator with organic vapor/ P3 cartridges	Levels within protection factor of the respirator
PID/FID Breathing Zone		100 ppm - 500 ppm	Evacuate area Level B Supplied Air Respirators required	May exceed protection factor and maximum use concentration for the cartridges
PID/FID	Breathing Zone	> 500 ppm	Evacuate area	Potential IDLH
PID/FID	Downwind Work Zone Perimeter	> 5 ppm or odors	Stop work, use windsock to determine wind direction, evaluate sources	Potential offsite exposures
CGI/O ₂ Meter	Work Area	1% LEL < Conc. < 10% LEL	Investigate possible causes, use caution during procedures	Potential for ignition of vapors
CGI/O ₂ Meter	Work Area	Conc. > 10% LEL	Stop work; withdraw from work area; notify ARCS II HSM	Increased potential for ignition of vapors
CGI/O ₂ Meter	Bore Hole	1% LEL < Conc. < 20% LEL	Proceed with caution, monitor borehole each time auger bit is removed.	Potential for ignition of vapors
CGI/O ₂ Meter Bore Hole		Conc. > 20% LEL	Stop work; allow hole to vent.	Increased potential for ignition of vapors
Oxygen meter	Breathing Zone	< 19.5%	Stop work; withdraw from work area; notify ARCS II HSM	Low oxygen
Oxygen meter	Breathing Zone	> 22%	Stop work; withdraw from work area; notify ARCS II HSM	Oxygen enriched atmosphere; explosion hazard
Dust Meter	Breathing Zone or Work Area	$0 - 0.2 \text{ mg/m}^3$, 15 minute avg.	No respiratory protection	Below potential exposure to lead and PCBs
Dust Meter	Breathing Zone or Work Area	0.2 mg/m ³ – 1.0 mg/m ³	Level C respirator with OV/P3 cartridges, institute dust suppression	Potential exposure to lead and PCBs near TWA
Dust Meter	Breathing Zone or Work Area	> 1.0 mg/m ³	Stop work, continue dust suppression measures	Potential offsite exposures

7.3 Noise Monitoring

Work areas or tasks that pose an exposure risk greater than 85 dBA will require hearing protection. If there is a reasonable possibility that workers may be exposed to an 8-hour time-weighted average exceeding 85 dBA, noise monitoring will be conducted in accordance with Foster Wheeler Environmental Health and Safety Program EHS 4-4 for Hearing Conservation.

7.4 Temperature Extremes Monitoring

A heat stress prevention program will be implemented when ambient temperatures exceed 70° F for personnel wearing impermeable clothing and for other personnel when the WBGT index exceeds the ACGIH TLVs. Temperature extremes monitoring will be conducted in accordance with Foster Wheeler Environmental Health and Safety Program EHS 4-6. The program can be found in Appendix F.

8.0 ZONES, CONTAMINATION CONTROL, AND COMMUNICATIONS

8.1 Site Control

Site zones are intended to control the potential spread of contamination throughout the Site and to ensure that only authorized individuals are permitted into potentially hazardous areas. A three-zone approach will be utilized. It shall include an Exclusion Zone (EZ), Contamination Reduction Zone (CRZ) and a Support Zone (SZ). Specific zones shall be established on the work Site when operations begin.

The following shall be used for guidance in revising these preliminary zone designations, if necessary.

Support Zone - The SZ is an uncontaminated area that will be the field support area for most operations. For this small-scale remediation project, the SZ will likely be comprised of the parking area for field vehicles, and will provide for field team communications and staging for emergency response. Appropriate safety equipment will be located within this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples.

Contamination Reduction Zone - The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides for an area for decontamination of personnel and portable hand-held equipment, tools and heavy equipment. If multiple exclusion zones are defined, a personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for Exclusion Zone entry and egress in addition to access for heavy equipment and emergency support services.

Exclusion Zone - All activities, which may involve exposure to Site contaminants, hazardous materials and/or conditions, should be considered an Exclusion Zone (EZ). This zone will be clearly delineated by cones, tapes or other means. The ESS may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ shall be determined by the Site ESS allowing adequate space for field team members and emergency equipment and for the planned activity to be completed.

8.2 Contamination Control

8.2.1 Personnel Decontamination Station

Good personal hygiene, coupled with diligent decontamination, will significantly reduce the potential for exposure.

8.2.2 Minimization of Contact with Contaminants

During completion of all Site activities, personnel should attempt to minimize the degree of contact with contaminated materials. This involves a conscientious effort to keep "clean" during site

activities. All personnel should minimize kneeling, splash generation, and other physical contact with contamination, and, whenever possible, stand upwind to minimize exposure to airborne contaminants. This may ultimately minimize the degree of decontamination required and the generation of waste materials from Site operations.

Field procedures will be developed to control over spray and runoff and to ensure that unprotected personnel working nearby are not affected.

8.2.3 Personnel Decontamination Sequence

Consideration will be given to prevailing wind directions so that the decontamination line, the support zone, and contamination reduction zone exit is upwind from the exclusion zone and the first station of the decontamination line. Decontamination will be performed by removing all PPE used in EZ and placing in drums/trash cans at CRZ. Baby wipes shall be available for wiping hands and face.

8.2.4 Emergency Decontamination

If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination, wrap injured personnel with clean garments/blankets to avoid contaminating other personnel or transporting equipment.

If the injured person can be moved, he/she will be moved to the exclusion zone boundary and decontaminated by Site personnel as described above before emergency responders handle the victim. If the person cannot be moved because of the extent of the injury (a back or neck injury) provisions shall be made to ensure that emergency response personnel will be able to respond to victim without being exposed to potentially hazardous atmospheric conditions. If the potential for inhalation hazards exist, such as with open excavation, this area will be covered with polyethylene to eliminate any potential inhalation hazards. All emergency personnel are to be immediately informed of the injured person's condition, potential contaminants, and provided with all pertinent chemical data.

8.2.5 Hand Held Equipment Decontamination

Hand held equipment includes all monitoring instruments, samples, hand tools, and notebooks. The hand held equipment is dropped at the first decontamination station to be decontaminated by one of the decontamination team members. These items must be decontaminated or discarded as waste prior to removal from the exclusion zone.

To aid in decontamination, monitoring instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants. The instruments will be wiped clean using wipes or paper towels if contamination is visually evident.

Decontamination procedures for sampling equipment, hand tools, etc., shall include the use of steam cleaning or a detergent wash, as appropriate for the Site conditions.

8.2.6 Heavy Equipment Decontamination

Decontamination of chemically contaminated heavy equipment will be accomplished using high pressure steam. Decontamination shall take place on a decontamination pad and all liquids used in the decontamination procedure will be collected. Vehicles or equipment which are brought into an exclusion zone will be treated as contaminated, and will be decontaminated prior to removal. All liquids used in the decontamination procedure will be collected, stored and disposed of in accordance with federal, state and local regulations. Personnel performing this task will wear the proper PPE as prescribed in Table 6-1.

8.3 Communications

The following communications equipment shall be specified as appropriate:

- Telephones A telephone will be located in the site trailer for communication with emergency support services/facilities and the home office.
- Radios Walkie-talkie type radios shall be used by remote field teams to communicate with each other and with the site trailer.
- Hand Signals Hand signals shall be used by field teams along with the buddy system.
 They shall be known by the entire field team before operations commence and their use covered during site-specific training. Typical hand signals are the following:

Signal State State Signal	Meaning Meaning
Hand gripping throat	Out of air, can't breathe
Grip on a partner's wrist or placement of both hands around a partner's waist	Leave area immediately, no debate
Hands on top of head	Need assistance
Thumbs up	Okay, I'm all right, I understand.
Thumbs down	No, negative.

THIS PAGE WAS INTENTIONALLY LEFT BLANK FOR PAGINATION PURPOSES

9.0 MEDICAL SURVEILLANCE PROCEDURES

All contractor and subcontractor personnel performing field work where potential exposure to contaminants exists at the site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120(f).

The Foster Wheeler Environmental Corporate Medical Surveillance Program is described in detail in Foster Wheeler Environmental Health and Safety Program EHS 4-5. The Corporate Medical Consultant is Greaney Medical Group in California.

9.1 Medical Surveillance Requirements

A physician's medical release for work will be confirmed by the ESS before an employee can work in the exclusion zone. The examination will be taken annually at a minimum and upon termination of hazardous waste Site work if the last examination was not taken within the previous six months. Additional medical testing may be required by the PESM in consultation with the Corporate Medical Consultant and the ESS if an over-exposure or accident occurs, if an employee exhibits symptoms of exposure, or if other Site conditions warrant further medical surveillance.

9.2 Medical Data Sheet

A medical data sheet is provided in Appendix E. This medical data sheet is voluntary and should be completed by all on-site personnel and will be maintained at the site. Where possible, this medical data sheet will accompany the personnel needing medical assistance. The medical data sheet will be maintained in a secure location, treated as confidential, and used only on a need-to-know basis.

10.0 SAFETY CONSIDERATIONS FOR SITE OPERATIONS

10.1 General

The ESS will be present on-site at all times during work activities and shall provide all monitoring and health and safety support in order to ensure the adequacy of protective equipment and safety procedures.

10.2 Safety Considerations During Field Operations

During all activities, personnel shall strictly adhere to the following procedures:

- The buddy system or line of sight will be used during intrusive work;
- If field personnel perceive an unsafe condition or situation, the ESS will be notified immediately; and
- All Site personnel shall be aware of the FWENC work rules (see Appendix E).

10.3 Sample Handling

Personnel responsible for the handling of samples should wear the prescribed level of protection. Samples should be identified as to their hazard and packaged as to prevent spillage or breakage. Sample containers shall be decontaminated in the CRZ or EZ before entering a clean Support Zone area. Any unusual sample conditions, odors, or real-time readings should be noted. Laboratory personnel should be advised of sample hazard level and the potential contaminants present. This can be accomplished by a phone call to the lab coordinator and/or including a written statement with the samples reviewing lab safety procedures in handling, in order to assure that the practices are appropriate for the suspected contaminants in the sample.

10.4 Drill Rigs

When conducting drilling activities, the opportunity of encountering fire and explosion hazards exists from underground utilities and gases. The locations of underground utilities will be verified prior to performing any intrusive activities. Additionally, because of the inherently hazardous nature of drilling operations, safety and accident prevention are crucial when drilling operations are performed. Most drilling accidents occur as a direct result of lack of training and supervision, improper handling of equipment, and unsafe work practices. Hazards include: assembling and disassembling rigs, rotary and auger drilling, and grouting. The drilling safety guidelines are contained in the FWENC Drill Rig Safety Program EHS 6-2 (see Appendix F).

10.5 Excavation and Trenching

Excavation will be conducted in accordance with the FWENC Environmental, Health and Safety Program for Excavation and Trenching, EHS 6-3; this program can be found in Appendix F. Procedures in this document incorporate the requirements of 29 CFR 1926, Subpart P-Excavations. It provides for the designation of a "Competent Person" and general requirements for safe excavating

practices. The program also incorporates company standards for the monitoring of potentially hazardous atmospheres; protection from water hazards; analyzing and maintaining the stability of adjacent structures; daily competent person inspections; soil classification; sloping and benching; protective systems; and training.

The Competent Person will be the Field Operations Leader or other designee with appropriate training and experience. The Competent Person will be assisted in his/her duties by other Foster Wheeler Environmental technical personnel such as the ESS, PESM, geologists, structural engineers and soils engineers.

Excavations and trenches 4 feet or greater in depth will require atmospheric monitoring and ladders for safe entry/egress. The Competent Person will determine the need for cave-in protection. If trenches exceed 5 feet in depth and personnel will enter, cave-in protection will be implemented in accordance with 29 CFR 1926, Subpart P.

11.0 WASTE MANAGEMENT PLAN

11.1 Introduction

11.1.1 Description

This plan addresses that portion of Foster Wheeler Environmental's work that deals with the management of wastes generated during the field investigation.

11.1.2 Regulatory Parameters and Assumptions

This plan has been drafted based on the following parameters and assumptions:

- The Cornell-Dubilier Site has been identified by USEPA as the extent of all surface and subsurface contamination;
- USEPA has designated the entire Cornell-Dubilier Site as an Area of Contamination (AOC) as that term is defined under the National Contingency Plan (NCP), 55 FR 8760 (March 8, 1990);
- The USEPA will be the generator of record for all wastes generated at the Site and the ID No. for the generation of any hazardous wastes will be provided by USEPA Region II:
- All work performed at the Site is being conducted in compliance with the instructions
 of USEPA Region II and will conform to the National Contingency Plan (NCP), 40
 CFR 300 et seq.; and
- A licensed driller who will be responsible for obtaining the necessary NJDEP well drilling approvals will install wells.

11.2 Regulatory Drivers And Guidance

The primary drivers for the waste management activities at this Site are provided below:

- <u>USEPA Management of Investigation-Derived Wastes During Site Inspections, EPA 540</u> <u>G-91-009, May 1991</u> - issued under CERCLA and the NCP to provide guidance on how investigation-derived wastes are to be managed at Superfund sites.
- NJDEP's Hazardous Waste Regulations, NJAC 7:26G-1.1 et seq. which provide the hazardous waste management regulations for generating, storing, treating, disposing and transporting hazardous wastes.
- NJDEP's Solid Waste Regulations, NJAC 7:26 -1.1 et seq. which provide the solid waste management requirements for generating, storing, treating, disposing and transporting solid wastes.
- <u>USEPA TSCA Regulations</u>, 40 <u>CFR 761</u> which provide requirements for the storage, handling and disposal of PCB contaminated wastes.

- <u>USDOT Regulations</u>, 49 <u>CFR 172</u>, et seq. which provide the requirements for packaging and transporting wastes on public roadways.
- National Contingency Plan, 40 CFR 300 which provides USEPA's overall "blueprint" for performing investigation and remedial work under CERCLA including USEPA's Off-Site Rule which requires all off-site facilities that receive CERCLA wastes to be approved by USEPA (40 CFR 300.440).
- Foster Wheeler Environmental's Waste Management Subcontractor Qualification Procedure (EHS 1-4) which provides the procedure for reviewing waste vendors and evaluating their regulatory enforcement record.

11.3 Expected Waste Streams and Quantities

11.3.1 Contaminants of Concern

The primary contaminants of concern at the Cornell-Dubilier Site and estimated maximum concentrations are provided below:

Contaminant	Matrix	Concentration (ppm)
Aroclor-1254	surface soil	51,000
Lead	surface soil	66,600

11.3.2 Waste Streams and Estimated Quantities

The primary waste streams to be generated during this project and the proposed storage/disposal methods are provided below:

Waste Stream	Estimated Quantity	Anticipated Classification	Storage/Disposal Method
Clearing Debris/Vegetative Waste	$< 10 \text{ yd}^3$	Non-haz	On-site Disposal
Drill cuttings (soil, rock)	167 drums	Haz/TSCA	Drums/off-site disposal
Well development water (Phase I: 10 overburden wells and 2-3 bedrock wells), purge water, and decontamination water.	41 drums	Non-haz	Drums/off-site disposal
Personal protective equipment (PPE)/ Plastic Sheeting/Miscellaneous Debris	37 drums	Non-haz	Drums/off-site disposal

11.4 Waste Management Requirements

11.4.1 Clearing Debris/Vegetative Wastes

These materials may be cut away at or above ground level in the vicinity of the locations where monitoring wells and soil borings/test pits are to be installed. It is unlikely that these materials will be affected by surficial contamination. Accordingly, vegetative wastes may be treated as non-hazardous vegetative wastes. These materials may be bundled and left on site.

11.4.2 Drill Cuttings

Drill cuttings containing soils and rock will be generated from the installation and/or replacement of wells, soil borings, and test pits. Given the concentrations of lead in Site soils, it is anticipated that the drill cuttings will be managed as hazardous waste (D008 characteristic hazardous waste). Based on information reviewed to date, there is insufficient background information to characterize the chemical wastes at this Site as listed hazardous wastes. Additionally, certain Site soils are likely to contain high concentrations of PCB contamination. These soils should be segregated from other Site wastes to minimize the total amount of soil - subject to TSCA regulation.

At a minimum, prior to characterization, all drill cuttings and related soils must be staged in a manner that does not pose a threat to health or the environment. For example, the soils should not be placed within proximity to a monitoring well, within or adjacent to an environmentally sensitive area (e.g., wetlands, stream bank, etc.) or near a Site boundary adjacent to stormwater catch basins or residential/commercial uses.

A representative sample of the waste will be collected by the transportation/disposal contractor and analyzed for RCRA disposal parameters. If the soils are determined to be hazardous waste, the requirements in Table 11-1 must be followed. If PCB concentrations in the waste are ≥ 50 ppm, the requirements in Table 11-2 must be followed. USEPA, in consultation with Foster Wheeler Environmental, will determine the source of any PCB contamination prior to storage and final disposal. PCB and waste requirements include those pertaining to the storage, transport and tracking of wastes from the point of generation to the ultimate permitted disposal facility. Soils which are non-hazardous and contain < 50 ppm PCBs may be managed in accordance with the solid waste requirements contained in Table 11-3.

11.4.3 Well Installation/Development/Purging and Decontamination Wastewaters

Wastewaters will be generated as the monitoring wells are drilled, developed and subsequently purged for sampling. In addition, decontamination wastewaters will also be generated. Wastewaters will be potentially contaminated with volatile organics, metals and PCBs. The following assertions support the conclusion that the wastewaters can be classified as non-hazardous waste pending further characterization sampling:

- 1. There is insufficient information to characterize the chemical wastes at this Site as listed hazardous wastes;
- 2. Given No. 1, above, the "contained in" policy for hazardous waste does not apply; and
- 3. Concentrations of contaminants are expected to be dilute.

Accordingly, wastewaters are to be managed as non-hazardous wastes pending further characteristic testing to be performed by the transportation/disposal contractor. The drilling subcontractor will collect well development and a portion of the purge waters in drums that will be transported to each well drilling site. DOT-approved (USDOT 1A1) steel 55-gallon drums will be used to collect all other wastewaters, including decontamination wastewaters. As drums reach full capacity, they will be transported to the drum storage area by Foster Wheeler Environmental personnel for eventual off-site transportation and disposal.

TABLE 11-1 (Sheet 1 of 2) SMALL QUANTITY HAZARDOUS WASTE GENERATOR REQUIREMENTS

Regulatory Standard	Requirements		
Hazardous Waste	 TCLP testing will be used to verify if waste is hazardous 		
Determination	Wastes will also be tested for PCB content		
EPA Identification Number	USEPA ID No. needed if waste is hazardous		
Packaging	 Soils must be placed in USDOT Type 1A2 steel drums (open top) Liquid wastes are to be placed in USDOT Type 1A1 steel drums (closed top) 		
Labeling	 NJDEP Hazardous waste labels - must be affixed to each drum when the first quantity of soil is placed in the drum. Labels must contain the following information: Wording: "Hazardous Waste - Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the USEPA." must be on each label Generator's Name: USEPA, Region II Address: c/o 290 Broadway, New York, NY Accumulation Start Date: Date first quantity of waste is placed in drum USEPA Waste Number: To be Determined (TBD) USEPA ID Number: TBD Manifest Document Number: TBD, but must match unique manifest number USDOT Labels - must be affixed to each drum containing a hazardous waste before the drum is shipped. USDOT labels are pre-printed designating the hazard class of the material. Most likely, if the soils are hazardous, the drums will require a Class 9 DOT label. 		
Placarding	 Placards declaring the USDOT Hazard Class of the waste must be provided to the transporter of the waste by the shipper. 		
Manifesting	 Manifests from the state to which the waste is shipped are to be used. If the state does not have its own manifests, then NJDEP manifests will be used. 		

TABLE 11-1 (Sheet 2 of 2) SMALL QUANTITY HAZARDOUS WASTE GENERATOR REQUIREMENTS

Regulatory Standard	Requirements
Accumulation/On-site Storage Time	 Small Quantity Generator (SQG) - 180 days maximum or 270 days if TSDF is located more than 200 miles away (see below for additional requirements for SQGs) If SQG maximum quantities are exceeded, the maximum on-site storage time is 90 days
Small Quantity Generator Requirements	 Total quantity of waste accumulated on-site can never exceed 6,000 kilograms (12,200 lbs.) At all times there is at least one employee on the premises or on call Post the following information near telephone: Name and telephone number of the emergency coordinator Location of fire extinguishers and spill control material Fire Department telephone number
Container Requirements	 Refer to Attachment A and requirements below: Storage containers must be in good condition and be made of materials which are compatible with the waste being stored; Containers must be kept closed except to add or remove the oil and they must be managed to prevent leaking; Containers must be inspected every week looking for leaks or deterioration and results of the inspection must be documented in a weekly inspection log (see Attachment B); Containers must be marked with the date on which the accumulation period began (when waste is first placed in the container); Each container is labeled or marked clearly with the words HAZARDOUS WASTE; Containers destined for off-site shipment must be labeled and marked in accordance with USDOT hazardous materials requirements; and Appropriate hazardous waste training is provided to project personnel, contingency plans are available to address any fire, spill or emergency and appropriate emergency response equipment is available.

TABLE 11-2 TSCA PCB REQUIREMENTS

Regulatory Standard	Requirements		
USEPA Identification	• USEPA ID No. needed if waste contains ≥ 50 ppm PCBs.		
Packaging	See Table 11-1		
Labelling	 TSCA PCB Label - Must be affixed to all containers with PCB concentrations ≥ 50 ppm. USDOT Labels - See Table 11-1. Storage Area - PCB waste storage area to be marked with 		
Placarding	PCB label. • See Table 11-1		
Manifesting	See Table 11-1		
Accumulation/On-site Storage Time	• PCB Waste Storage- Wastes containing PCBs ≥ 50 ppm may be stored on-site in containers for a maximum of 30 days. Alternatively, PCB remediation wastes may be stored in a storage pile that meets the requirements of 40 CFR 761.65(c)(9) for up to 180 days.		
Container Requirements	 Date placed in storage clearly marked on container; Inspect to ensure no leaks; Document inspections; Storage limited to non-leaking PCB articles and equipment, containers storing soil, rags and debris and liquids > 50 ppm but < 500 ppm if a SPCC Plan is in place. 		

TABLE 11-3 NJDEP SOLID WASTE GENERATOR REQUIREMENTS

Regulatory Standard	Requirements
Solid Waste Determination	Wastes which are not hazardous wastes as described in Table
	11-1 are to be managed as solid waste
EPA Identification Number	No USEPA ID No. needed
Packaging	• Soils must be placed in USDOT Type 1A2 steel drums (open
	top)
	• Liquid wastes are to be placed in USDOT Type 1A1 steel
	drums (closed top)
	• Solid wastes are to be placed in USDOT Type 1A2 steel
	drums (open top)
Labeling	• Non-hazardous waste labels – may be affixed to each drum
	when the first quantity of soil is placed in the drum. Labels
	must contain the following information:
	Wording: "Non-Hazardous Waste" should appear in
·	Bold lettering on the label
	Shipper's Name: USEPA, Region II Address 200 Peradown New York NIV
	• Address: 290 Broadway, New York, NY
	• Contents: Description of contents USDOT Labels must be offined to each draw containing a
	• <u>USDOT Labels</u> - must be affixed to each drum containing a hazardous waste before the drum is shipped. USDOT labels
	are pre-printed designating the hazard class of the material.
	Most likely, if the wastes are non-hazardous, the drums will
	not require DOT labels (with the exception of soils with
	strong odors, which are to be managed as DOT Class 9
	materials). This should be confirmed based on sample results
	prior to shipment.
Placarding	Placards declaring the USDOT Hazard Class of the waste
	must be provided to the transporter of the waste by the
	shipper.
Bill of Lading	A bill of lading detailing the name and addresses of the
	generator, transporter and disposal facility and the weight and
	description of the contents should be completed by the
(,	transporter prior to the off-site shipment of material.
Accumulation Time	• 180 days

To confirm that the wastewaters are not hazardous wastes, a representative sample of the wastewater will be collected by the transportation/disposal contractor. This sample or samples will be analyzed for TCLP parameters to confirm the material is non-hazardous and for PCB contamination. In anticipation of the analytical results being negative, the management procedures in Table 11-1 will apply.

In the unlikely event that the wastewaters test positively as a characteristic hazardous waste or TSCA regulated, the management procedures detailed in Table 11-2 and Table 11-3, respectively, will apply.

11.5 Waste Transporters and Disposal Approvals

11.5.1 Transporters

Transporters for the removal of solid and hazardous wastes must be approved prior to use. Transporters will be retained following regulatory review and approval by Foster Wheeler pursuant to EHS 1-4. Transporters are reviewed for permitting requirements, licenses and regulatory enforcement status.

11.5.2 Disposal Facilities

Solid and hazardous waste treatment/disposal facilities must be approved by both Foster Wheeler and USEPA, pursuant to the off-site rule (40 CFR 300.440), prior to use. (USEPA alone will review the Off-Site approval status).

11.6 Waste Documentation and Notification Requirements

11.6.1 Hazardous Waste

USEPA Region II will be the generator of record for this project and will provide the USEPA ID Number for the shipment of hazardous wastes. Therefore, no prior notification to USEPA or NJDEP will be required by Foster Wheeler for the shipment of hazardous wastes. Project personnel will obtain manifests from either the NJDEP or the waste transporters. Foster Wheeler personnel will complete manifests. Foster Wheeler is authorized by contract to sign the waste manifests on USEPA's behalf. If a USEPA representative is on-site at the time of the shipment, the USEPA representative will sign the manifests. Foster Wheeler or the USEPA representative will distribute manifests. Return copies of the manifests will be sent to USEPA Region II, 290 Broadway, New York, NY. Accordingly, USEPA will be responsible for filing any exception reports that are needed if the return copies of the manifest are not received from the disposal facility within 20 days of the shipment. USEPA, as generator, will be responsible for any generator reports that need to be filed with NJDEP.

11.6.2 Solid Waste

USEPA Region II will be the generator of record for all solid wastes transported from the site. No prior notification for the solid waste shipments will be required. The transporter will complete a NJDEP Origin and Disposal Form (bill of lading) corresponding to each shipment of solid waste. Common practice is for Foster Wheeler to sign non-hazardous waste documents on behalf of EPA although Foster Wheeler is not specifically authorized or prohibited from doing so by contract. One copy of the O&D Form will be retained by Foster Wheeler for the project files. No return copies of the O&D Form need to be submitted to Foster Wheeler.

ATTACHMENT A NJDEP DRUM STORAGE AREA REQUIREMENTS

THINDE 40 PROTECTION OF ENVIRONMENT

PART 262—STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE

40 CFR 262.34 Accumulation time.

- (2) The date upon which each period of accumulation begins is clearly marked and visible for inspection on each container;
- (3) While being accumulated on-site, each container and tank is labeled or marked clearly with the words, "Hazardous Waste"; and

Subpart C—Preparedness and Prevention

40 CFR 265.30 Applicability.

The regulations in this subpart apply to owners and operators of all hazardous waste facilities, except as §265.1 provides otherwise.

40 CFR 265.31 Maintenance and operation of facility.

Facilities must be maintained and operated to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water which could threaten human health or the environment.

40 CFR 265.32 Required equipment.

All facilities must be equipped with the following, *unless* none of the hazards posed by waste handled at the facility could require a particular kind of equipment specified below:

- (a) An internal communications or alarm system capable of providing immediate emergency instruction (voice or signal) to facility personnel;
- (b) A device, such as a telephone (immediately available at the scene of operations) or a hand-held two-way radio, capable of summoning emergency assistance from local police departments, fire departments, or State or local emergency response teams;
- (c) Portable fire extinguishers, fire control equipment (including special extinguishing equipment, such as that using foam, inert gas, or dry chemicals), spill control equipment, and decontamination equipment; and
- (d) Water at adequate volume and pressure to supply water hose streams, or foam producing equipment, or automatic sprinklers, or water spray systems.

40 CFR 265.33 Testing and maintenance of equipment.

All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, must be tested and maintained as

necessary to assure its proper operation in time of emergency.

40 CFR 265.34 Access to communications or alarm system.

- (a) Whenever hazardous waste is being poured, mixed, spread, or otherwise handled, all personnel involved in the operation must have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee, *unless* such a device is not required under §265.32.
- (b) If there is ever just one employee on the premises while the facility is operating, he must have immediate access to a device, such as a telephone (immediately available at the scene of operation) or a hand-held two-way radio, capable of summoning external emergency assistance, unless such a device is not required under §265.32.

40 CFR 265.35 Required aisle space.

The owner or operator must maintain aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency, *unless* aisle space is not needed for any of these purposes.

40 CFR 265.36 [Reserved]

40 CFR 265.37 Arrangements with local authorities.

- (a) The owner or operator must attempt to make the following arrangements, as appropriate for the type of waste handled at his facility and the potential need for the services of these organizations:
- (1) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of hazardous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to roads inside the facility, and possible evacuation routes;
- (2) Where more than one police and fire department might respond to an emergency, agreements designating primary emergency authority to a specific police and a specific fire department, and agreements with any others to provide support to the primary emergency authority;
- (3) Agreements with State emergency response teams, emergency response contractors, and equipment suppliers; and
- (4) Arrangements to familiarize local hospitals with the properties of hazardous waste handled at the facility and the types of injuries or illnesses which could result from fires, explosions, or releases at the facility.
- (b) Where State or local authorities decline to enter into such arrangements, the owner or operator must document the refusal in the operating record.

Subpart D—Contingency Plan and Emergency Procedures

40 CFR 265.50 Applicability.

The regulations in this subpart apply to owners and operators of all hazardous waste facilities, except as §265.1 provides otherwise.

40 CFR 265.51 Purpose and implementation of contingency plan.

- (a) Each owner or operator must have a contingency plan for his facility. The contingency plan must be designed to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water.
- (b) The provisions of the plan must be carried out immediately whenever there is a fire, explosion, or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment.

40 CFR 265.52 Content of contingency plan.

- (a) The contingency plan must describe the actions facility personnel must take to comply with §§265.51 and 265.56 in response to fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water at the facility.
- (b) If the owner or operator has already prepared a Spill Prevention, Control, and Countermeasures (SPCC) Plan in accordance with part 112 of this chapter, or part 1510 of chapter V, or some other emergency or contingency plan, he need only amend that plan to incorporate hazardous waste management provisions that are sufficient to comply with the requirements of this part.
- (c) The plan must describe arrangements agreed to by local police departments, fire departments, hospitals, contractors, and State and local emergency response teams to coordinate emergency services, pursuant to §265.37.
- (d) The plan must list names, addresses, and phone numbers (office and home) of all persons qualified to act as emergency coordinator (see §265.55), and this list must be kept up to date. Where more than one person is listed, one must be named as primary emergency coordinator and others must be listed in the order in which they will assume responsibility as alternates.
- (e) The plan must include a list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems (internal and external), and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.
- (f) The plan must include an evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by releases of hazardous waste or fires).

40 CFR 265.53 Copies of contingency plan.

A copy of the contingency plan and all revisions to the plan must be:

- (a) Maintained at the facility; and
- (b) Submitted to all local police departments, fire departments, hospitals, and State and local emergency response teams that may be called upon to provide emergency services.

40 CFR 265.54 Amendment of contingency plan.

The contingency plan must be reviewed, and immediately amended, if necessary, whenever:

- (a) Applicable regulations are revised;
- (b) The plan fails in an emergency;
- (c) The facility changes-in its design, construction, operation, maintenance, or other circumstances-in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes the response necessary in an emergency;
 - (d) The list of emergency coordinators changes; or
 - (e) The list of emergency equipment changes.

40 CFR 265.55 Emergency coordinator.

At all times, there must be at least one employee either on the facility premises or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures. This emergency coordinator must be thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, the location and characteristics of waste handled, the location of all records within the facility, and the facility layout. In addition, this person must have the authority to commit the resources needed to carry out the contingency plan.

[Comment: The emergency coordinator's responsibilities are more fully spelled out in §265.56. Applicable responsibilities for the emergency coordinator vary, depending on factors such as type and variety of waste(s) handled by the facility, and type and complexity of the facility.]

40 CFR 265.56 Emergency procedures.

- (a) Whenever there is an imminent or actual emergency situation, the emergency coordinator (or his designee when the emergency coordinator is on call) must immediately:
- (1) Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel; and
- (2) Notify appropriate State or local agencies with designated response roles if their help is needed.
- (b) Whenever there is a release, fire, or explosion, the emergency coordinator must immediately identify the character, exact source, amount, and a real extent of any released materials. He may do this by observation or review of facility records or manifests and, if necessary, by chemical analysis.

- (c) Concurrently, the emergency coordinator must assess possible hazards to human health or the environment that may result from the release, fire, or explosion. This assessment must consider both direct and indirect effects of the release, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water run-offs from water or chemical agents used to control fire and heat-induced explosions).
- (d) If the emergency coordinator determines that the facility has had a release, fire, or explosion which could threaten human health, or the environment, outside the facility, he must report his findings as follows:
- (1) If his assessment indicates that evacuation of local areas may be advisable, he must immediately notify appropriate local authorities. He must be available to help appropriate officials decide whether local areas should be evacuated; and
- (2) He must immediately notify either the government official designated as the on-scene coordinator for that geographical area (in the applicable regional contingency plan under part 1510 of this title), or the National Response Center (using their 24-hour toll free number 800/424-8802). The report must include:
 - (i) Name and telephone number of reporter;
 - (ii) Name and address of facility;
 - (iii) Time and type of incident (e.g., release, fire);
 - (iv) Name and quantity of material(s) involved, to the extent known;
 - (v) The extent of injuries, if any; and
 - (vi) The possible hazards to human health, or the environment, outside the facility.
- (e) During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous waste at the facility. These measures must include, where applicable, stopping processes and operations, collecting and containing released waste, and removing or isolating containers.
- (f) If the facility stops operations in response to a fire, explosion or release, the emergency coordinator must monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.
- (g) Immediately after an emergency, the emergency coordinator must provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility.

[Comment: Unless the owner or operator can demonstrate, in accordance with §261.3(c) or (d) of this chapter, that the recovered material is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of parts 262, 263, and 265 of this chapter.]

(h) The emergency coordinator must ensure that, in the affected area(s) of the facility:

- (1) No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed; and
- (2) All emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed.
- (i) The owner or operator must notify the Regional Administrator, and appropriate State and local authorities, that the facility is in compliance with paragraph (h) of this section before operations are resumed in the affected area(s) of the facility.
- (j) The owner or operator must note in the operating record the time, date, and details of any incident that requires implementing the contingency plan. Within 15 days after the incident, he must submit a written report on the incident to the Regional Administrator. The report must include:
 - (1) Name, address, and telephone number of the owner or operator;
- (2) Name, address, and telephone number of the facility;
- (3) Date, time, and type of incident (e.g., fire, explosion);
- (4) Name and quantity of material(s) involved;
- (5) The extent of injuries, if any;
- (6) An assessment of actual or potential hazards to human health or the environment, where this is applicable; and
 - (7) Estimated quantity and disposition of recovered material that resulted from the incident.

Subpart I—Use and Management of Containers

40 CFR 265.170 Applicability.

The regulations in this subpart apply to owners and operators of all hazardous waste facilities that store containers of hazardous waste, except as §265.1 provides otherwise.

40 CFR 265.171 Condition of containers.

If a container holding hazardous waste is not in good condition, or if it begins to leak, the owner or operator must transfer the hazardous waste from this container to a container that is in good condition, or manage the waste in some other way that complies with the requirements of this part.

40 CFR 265.172 Compatibility of waste with container.

The owner or operator must use a container made of or lined with materials which will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired.

40 CFR 265.173 Management of containers.

- (a) A container holding hazardous waste must always be closed during storage, except when it is necessary to add or remove waste.
- (b) A container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak.

[Comment: Re-use of containers in transportation is governed by U.S. Department of Transportation regulations, including those set forth in 49 CFR 173.28.]

40 CFR 265.174 Inspections.

The owner or operator must inspect areas where containers are stored, at least weekly, looking for leaks and for deterioration caused by corrosion or other factors.

[Comment: See §265.171 for remedial action required if deterioration or leaks are detected.]

40 CFR 265.175 [Reserved]

40 CFR 265.176 Special requirements for ignitable or reactive waste.

Containers holding ignitable or reactive waste must be located at least 15 meters (50 feet) from the facility's property line.

[Comment: See §265.17(a) for additional requirements.]

40 CFR 265.177 Special requirements for incompatible wastes.

- (a) Incompatible wastes, or incompatible wastes and materials, (see appendix V for examples) must not be placed in the same container, unless §265.17(b) is complied with.
- (b) Hazardous waste must not be placed in an unwashed container that previously held an incompatible waste or material (see appendix V for examples), unless §265.17(b) is complied with.
- (c) A storage container holding a hazardous waste that is incompatible with any waste or other materials stored nearby in other containers, piles, open tanks, or surface impoundments must be separated from the other materials or protected from them by means of a dike, berm, wall, or other device.

[Comment: The purpose of this is to prevent fires, explosions, gaseous emissions, leaching, or other discharge of hazardous waste or hazardous waste constituents which could result from the mixing of incompatible wastes or materials if containers break or leak.]

ATTACHMENT B DRUM STORAGE AREA INSPECTION REPORT

Figure 5-2 • Example Drum Inspection Checklist

Weekh	Contail	ner/Drum Inspection	Log - Haza	rdous Wa	ste					
Projec	Name Number			Month Year		_		- .		
Date	Time	Inspector Signature	No. drums "full" in storage	No. drums satellife accum.	Drums marked and labeled?	Lids/bungs closed and labeled?	Signs of leakage	Overall condition?	Deficient items corrected	Comments
							<u>-</u>			
<u></u>										
			-							<u> </u>
		<u> </u>								

Federal regulations require that large quantity generators (LQG) maintain a 50-feet buffer zone from property lines for ignitable (D001) and reactive (D003)

waste (40 CFR 265.176). Small quantity generators (SOG) are not subject to this requirement. State criteria may differ.

Adequate asite space must be maintained in drum storage areas for unobstructed movement of personnel and fire/spil/decon equipment during an emergency (40 CFR 265.35).

	FOSTER 📆 WHEELER	
FOSTER	WHEELER ENVIRONMENTAL CORPORATIO	N

1997-98 - PROPRIETARY INFORMATION

12.0 EMERGENCY RESPONSE PLAN

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff are essential. Specific elements of emergency support procedures which are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on-site, record keeping, and emergency site evacuation procedures.

12.1 Responsibilities

12.1.1 Project Environmental and Safety Manager (PESM)

The PESM oversees and approves the Emergency Response/Contingency Plan and performs audits to determine that the plan is in effect and that all pre-emergency requirements are met. The PESM acts as a liaison to applicable regulatory agencies and notifies the regional ESQ manager of OSHA reportable accidents.

12.1.2 Environmental and Safety Supervisor (ESS)

The ESS is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. The ESS is required to immediately notify the PM and PESM of any fatalities or catastrophes (three or more workers injured and hospitalized) so that the PESM can notify OSHA within the required time frame. The PESM will be notified of all OSHA recordable injuries, fires, spills, releases or equipment damage in excess of \$500 within 24 hours.

12.1.3 Emergency Coordinator

The Emergency Coordinator is the Field Operations Leader.

In the event of an emergency, the Emergency Coordinator shall make contact with Local Emergency Response personnel. In these contacts, the Emergency Coordinator will inform response personnel about the nature of work on the Site, the type of contaminants and associated health or safety effects, and the nature of the emergency, particularly if it is related to exposure to contaminants.

The Emergency Coordinator shall review this plan and verify emergency phone numbers and hospital routes prior to beginning work on Site. The Emergency Coordinator shall make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator shall implement the Emergency Response/Contingency Plan whenever conditions at the Site warrant such action.

12.1.4 Site Personnel

Site personnel are responsible for knowing the Emergency Response/Contingency Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a Site emergency.

12.2 Communications

A variety of communication systems may be utilized during emergency situations. These are discussed in the following sections.

The primary form of communication during an emergency between field groups in the exclusion zone and the Emergency Coordinator will be verbal communications. During an emergency situation, the lines will be kept clear so that instructions can be received by all field teams.

12.2.1 Telephone Communications

A cellular telephone will be available on-site.

12.2.2 Air Horns

Air horns will be used to alert Site personnel of emergencies. The following signals will be used:

- Two short blasts shut down equipment, await instructions
- Three short blasts injured employee, first-aid providers respond
- One continuous blast Site evacuation

Air horns will be available in the site trailer and with each field team.

The procedure to activate the air horns consists of depressing the air horn button or switch while pointing it in the direction of the area to be signaled. Air horns should be tested at least monthly to ensure that they are working properly.

12.2.3 Hand Signals

Hand signals will be employed by downrange field teams where necessary for communication during emergency situations. Hand signals are found in Section 8.3.

12.3 Pre-Emergency Planning

Foster Wheeler Environmental will communicate directly with administrative personnel from the emergency room at the hospital in order to determine whether the hospital has the facilities and personnel needed to treat cases of trauma resulting from exposure to any of the contaminants expected to be found on the Site.

Before the field activities begin, the local emergency response personnel may be notified by the EC of the schedule for field activities and about the materials that are thought to exist on the site so that they will be able to respond quickly and effectively in the event of a fire, explosion, or other emergency.

In order to be able to deal with any emergency that might occur during remedial activities at the Site, emergency telephone numbers will be readily available in the site trailer. These telephone numbers are presented in Table 12-1. Hospital route maps will also be readily available in the site trailer and is presented in Appendix C. The Emergency phone numbers listed are preliminary. Upon mobilization the PM shall verify all numbers, and document any changes in the Site Logbook. Any changes shall be also documented with a field change request form.

Before field work on the Site commences, each person who will be working there or observing the operations will complete a medical data sheet. These data sheets will be filled out during the initial Site safety training meeting and will be kept on the Site. In the event of an incident where a team member has to be taken to a hospital, a copy of his/her medical data sheet will be presented to the attending physician.

12.4 Emergency Medical Treatment

The procedures and rules in this EHS Plan are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the ESS immediately. First-aid equipment will be available on-site in the Support Zone.

During the site safety briefing, project personnel will be informed of the location of the first aid station(s) that has been set up. Unless they are in immediate danger, severely injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

Foster Wheeler will provide at least two personnel with current First Aid and CPR certification on each active work shift. If personnel are transported to the hospital, the ESS will provide a copy of the Medical Data Sheet to the paramedics and treating physician. Only in **non-emergency** situations will an injured person be transported to the hospital by means other than an ambulance.

12.5 Emergency Site Evacuation Routes and Procedures

In the event of a Site Emergency that would require the evacuation of personnel, the Foster Wheeler Emergency Coordinator will immediately give the evacuation signal.

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs at the work area, including but not limited to fire, explosion or significant release of toxic gas into the atmosphere, immediate evacuation of all personnel is necessary due to an immediate or impending

TABLE 12-1 EMERGENCY TELEPHONE NUMBERS

EMERGENCY	TELEPHONE
SERVICE	NUMBER
Police	911
Fire	911
Ambulance	911
Hospital	732-321-7000
EPA National Response	800-424-8802
Center	
Poison Control Center	800-332-3073
Daniel Miller,	973-597-7107
Project Manager	
Joseph L. Sbarra, PESM	973-597-7101

danger. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at a pre-determined location.

As field activities are anticipated to last four months, an evacuation drill will be performed.

12.6 Fire Prevention and Protection

In the event of a fire or explosion, procedures will include immediately evacuating the work area, the Emergency Coordinator will immediately notify the local fire and police departments. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

Fires will be prevented by adhering to the following precautions:

- Good housekeeping and storage of materials
- Storage of flammable liquids and gases away from oxidizers
- No smoking in the exclusion zone or any work area
- No hot work without a properly executed hot work permit
- Shutting off engines to refuel
- Grounding and bonding metal containers during transfer of flammable liquids
- Use of UL approved flammable storage cans
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers and near all hot work activities
- Monthly inspections of all fire extinguishers

The person responsible for the maintenance of fire prevention and/or control equipment for the control of fuel source hazards is the FOL.

12.7 Overt Chemical Exposure

The following are standard procedures to treat chemical exposures. Other, specific procedures detailed on the Material Safety Data Sheets or recommended by the Corporate Medical Consultant will be followed, when necessary. If first aid or emergency medical treatment is necessary the Emergency Coordinator will contact the appropriate emergency facilities.

SKIN AND EYE Use copious amounts of soap and water. Wash/rinse affected areas

CONTACT: thoroughly, then provide appropriate medical attention. Eyes should be

rinsed for 15 minutes upon chemical contamination. Skin should also be rinsed for 15 minutes if contact with caustics, acids or hydrogen peroxide

occurs.

INHALATION: Move to fresh air. Decontaminate and transport to hospital or local

medical provider.

INGESTION: Decontaminate and transport to emergency medical facility.

PUNCTURE Decontaminate and transport to emergency medical facility.
WOUND OR
LACERATION:

12.8 Decontamination During Medical Emergencies

If emergency life-saving first aid and/or medical treatment is required, normal decontamination procedures may need to be abbreviated or postponed. The ESS or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on Site, a plastic barrier between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if his/her injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

12.9 Accident/Incident Reporting

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

- Project Environmental and Safety Manager, Joe Sbarra, 973-597-7101
- Project Manager, Dan Miller, 973-597-7107
- The employer of any injured worker who is <u>not</u> a Foster Wheeler employee.

Written confirmation of verbal reports are to be submitted within 24 hours. The accident/incident report is found in Appendix E. If the employee involved is not a Foster Wheeler employee, his employer shall receive a copy of the report.

12.10 Adverse Weather Conditions

In the event of adverse weather conditions, the FOL and ESS will determine if work can continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries
- Potential for cold stress and cold-related injuries
- Treacherous weather-related working conditions (hail, rain, snow, ice, high winds)
- Limited visibility (fog)
- Potential for electrical storms
- Earthquakes
- Other major incidents

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The ESS, in consultation with the FOL, will determine the

need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

12.11 Spill Control and Response

All small hazardous spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any caustic or acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas should be blocked. All spill containment materials will be properly disposed as hazardous waste. An exclusion zone of 50-100 feet around the spill area should be established depending on the size of the spill.

The following steps should be taken by the Emergency Coordinator:

- 1. Determine the nature, identity and amounts of major spill components;
- 2. Make sure all unnecessary persons are removed from the spill area;
- 3. Notify appropriate response teams and authorities;
- 4. Use proper PPE in consultation with the ESS;
- 5. If a flammable liquid, gas or vapor is involved, remove all ignition sources and use nonsparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.);
- 6. If possible, try to stop the leak with appropriate material; and,
- 7. Remove all surrounding materials that can react or compound with the spill.
- 8. Notify Joe Walsh, Livingston office Regulatory Affairs, 973-597-7376.

12.12 Emergency Equipment

The following minimum emergency equipment shall be kept and maintained on-site.

- Industrial first aid kit
- Portable eye washes
- Fire extinguishers (one per vehicle and heavy equipment)
- Absorbent material

12.13 Postings

The following information shall be posted or be readily visible and available at conspicuous locations throughout the site:

- Emergency telephone numbers;
- Hospital Route Map; and
- Evacuation Routes and Rally Point Map.

12.14 Restoration and Salvage

After an emergency, prompt restoration of utilities, fire protection equipment, medical supplies and other equipment will reduce the possibility of further losses. Some of the items that may need to be addressed are:

- Refilling fire extinguishers;
- Refilling medical supplies;
- Recharging eyewashes and/or showers
- Replenishing spill control supplies
- Replacing used air horns

13.0 TRAINING REQUIREMENTS

13.1 Site-Specific Training

Prior to commencement of field activities, all field personnel assigned to the project will be provided training that will specifically address the activities, procedures, monitoring and equipment for the site operations. It will include site and facility layout, hazards, and emergency services at the site, and will highlight all provisions contained within this EHS Plan. This training will also allow field worker to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

13.2 General Health and Safety Training (40 Hour OSHA Training)

In accordance with Foster Wheeler Environmental corporate policy, and pursuant to 29 CFR 1910.120, hazardous waste site workers shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations unless otherwise noted in the above reference. At a minimum, the training shall have consisted of instruction in the topics outlined in the standard. Personnel who have not met the requirements for initial training shall not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical).

13.3 Annual Eight-Hour Refresher Training

Annual eight-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualifications for field work. The training will cover a review of 1910.120 requirements and related company programs and procedures

13.4 On-Site Safety Briefings

Project personnel and visitors will be given daily on-site health and safety briefings by the FOL and ESS, to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices or the site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

13.5 First Aid and CPR

At least two site personnel shall have First Aid and CPR training in order to ensure that emergency medical treatment is available during field activities. The training will be consistent with the requirements of the American Red Cross Association.

13.6 Hazard Communication

Hazard communication training will be provided in accordance with the requirements contained in the FWENC Environmental Health and Safety Program EHS 4-2.

14.0 LOGS, REPORTS AND RECORDKEEPING

The following is a summary of required health and safety logs, reports and recordkeeping for the Cornell-Dubilier Site.

14.1 Field Change Request

The Field Change Request Form is to be completed for initiating a change to the EHS Plan. The PESM and Project Manager approval is required. The original will be kept in the project file.

14.2 On-Site Log

A log of personnel on-site each day will be kept by the FOL. Originals will be kept in the project file.

14.3 Health and Safety Reports

The ESS shall complete and submit Weekly Health and Safety Reports to the PESM. These reports are provided in Appendix E.

14.4 Accident/Incident Reports

A FosterWheeler Environmental accident/incident report must be completed following procedures given in Section 12.0 of this EHS Plan. The originals will be sent to the Regional Records Coordinator for maintenance by Foster Wheeler Environmental. Copies will be distributed as stated. A copy of the forms will be kept in the project file.

14.5 Material Safety Data Sheets

Material Safety Data Sheets (MSDS) will be obtained and kept on file at the project site for each hazardous chemical brought to, used, or stored at the site. The MSDSs will be located in a binder in the main trailer at the Site.

15.0 FIELD TEAM REVIEW

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the EHS Plan for the Hydrographic Survey activities at the Cornell-Dubilier Electronics Superfund site. It is maintained on site by the FOL/ESS as a project record.

Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, the EHS Plan and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	Date
· · · · · · · · · · · · · · · · · · ·	

APPENDIX A FIELD CHANGE REQUEST FORM

FOSTER WHEELER ENVIRONMENTAL FIELD CHANGE REQUEST FORM

PROJECT:			
CHANGE NUMBE	CR:		
PROJECT LOCAT	TION:		
	F CHANGE:		
DESCRIPTION OF			
DEASON FOR CH	IANCE.		
REASON FOR CH	ANGE:		
	· · · · · · · · · · · · · · · · · · ·		
RECOMMENDED	DISPOSITION:		
		·	
SITE MANAGER:			
	Signature	Date	
PROGRAM HEAL	TH AND SAFETY MANAGER:		
	Signature	Date	
DISTRIBUTION:	Program Health and Safety Manager		
	Environmental and Safety Supervisor		
	Quality Assurance Representative Field Operation Leader		

EHS PLAN FIELD CHANGE

Field Change Number:	Date Effective:		
Pen and Ink changes to be made in the EHS Plan to alert the reader of this change:			
Reason for the change to be incorporated into the EHS Plan:			
·			
TEXT OF CHANGE TO BE INCORPORATED:			
·			
· · · · · · · · · · · · · · · · · · ·			

FIELD CHANGE RECORDS

Record of Field Changes:

Initial for attaching any Field changes to this EHS Plan. Enter the Field Change Number and Date Issued. File the completed field changes to this EHS Plan at the end as attachments. Make PEN and INK changes in the text to alert the reader to the changes that are required in the Field Change.

FIELD CHANGE NUMBER	DATE ENTERED	SYNOPSIS OF CHANGE	INITIAL

APPENDIX B CHEMICAL DATA SHEETS

Date: 2/13/89 Update: 3/97 #9

CHEMICAL DATA SHEET

I.	Chemical/CompoundName	emical/CompoundName: Trichloroethylene(Trichloroethene)		
	A. Synonyms: TCE, Et	hylene Trichloride, Trilene, Trichloroethene		
	B. CAS #: 79-01-6			
	C. Formula: CHCl=CC	1 ₂ Mol. Weight: 131.4		
П.	Physical Characteristics			
	A. X Liquid	Solid Powder Gas		
	B. Color: Colorless			
	C. Odor: Chloroform-	like, sweet		
	E. Boiling Point 188°F	Flash Pt. None °F Melting Point -99°F		
	Ionization Potential:	9.45 eV Vapor Pressure: 285mm		
	F. Other: Detection Le	vel - 25 ppm		
Ш.	Recommended Air Purifying	ng Cartridge:		
	Dusts, Fumes, Mist	sAcid Gases		
	X Organic Vapors	Pesticides		
	HEPA	Air Purifying is Inappropriate		
	Ammonia/Amines	Other:		
IV	. Health Hazards Data			
	A. Routes of Entry: X	_ InhalationSkin Absorption X_Ingestion X Eye/Skin Contact		
	B. Human Carcinogen:	X No Not Enough Data Suspect Yes		
	Classifying Agency:	NIOSH _X_ACGIHOSHA		
	C. Sensitizer:No	X No Data Suspect Yes		
	D. Acute Toxicity:			
	Eye Contact:	Eye Irritant		
	Skin Contact:	act: Mildly irritating. Alcohol intake may potentiate cutaneous		
		vasodilation (redness of the skin). Prolonged use can cause		
		burning and dryness of skin.		
	Inhalation:	CNS Depressant, sometimes preeded by headache, nausea, mental		
		confusion, fatigue, incoordiantion, excitation or euphoria; a mild		
		irritant to respiratory system. Other effects are arrhythmias, liver		
	•	and kidney lesions, hypertension, coma or death.		
	E. Chronic Toxicity:			
	Target Organs:	Liver, kidneys, respiratory system, skin, CNS, Eyes		
	Long-Term Eff	fects: CNS depression, intolerance to alcohol and increased cardiac		
		output; symptoms abate when TCE is removed. Dermatitis, liver		
	•	and kidney damage.		
V.	Exposure Limits			
	A. OSHA PEL: 100 pp	m,TWA; 200 ppm, Ceiling; 300 ppm, 5 min./2 hr. peak		
	B. ACGIH TLV: 50 pp	m, (TWA) 269 mg/m ³		
	C. IDLH: 2,000 ppm			
	D. NIOSH REL: 25 ppr	<u>n (10-hr. TWA)</u>		
	E. STEL: 100 ppm			
Vī	Other Pertinent Information	n/SpecialPrecautions: NIOSH listed carcinogen. Odor threshold		
V 1.	determine as low as 22	- -		
		ppm.		
VII		•		
	ACGIH TLVs and BEI			
	Code of Federal Regula			
	NIOSH Pocket Guide to	o Chemical Hazards 1994		

Date: 8/90 Update:3/97 #33

CHEMICAL DATA SHEET

I.	Chemical/CompoundName: Aroclor 1254 (54% Chlorine) (Skin) A. Synonyms: Polychlorinated biphenyl, chlorodiphenyl, PCBs B. CAS #: 11097-69-1
II.	Physical Characteristics A. X Liquid Solid X Powder Gas B. Color: colorless (liquid) with light-dark yellow (resin/wax) or white to yellow (powder) C. Odor: aromatic hydrocarbon odor D. LEL % Flash Pt. 432°F E. Boiling Point 689-734°F Melting Point 50°F Ionization Potential Vapor Pressure: F. Other:
III.	Recommended Air Purifying Cartridge:
	X Dusts, Fumes, Mists Acid Gases
	X Organic VaporsPesticides
	X HEPAAir Purifying is Inappropriate
	Ammonia/AminesOther:
	A. Routes of Entry: X Inhalation X Skin Absorption X Ingestion Skin/Eye Contact B. Human Carcinogen: No Not Enough Data Suspect X Yes Classifying Agency: X NIOSH ACGIH OSHA C. Sensitizer: No No Data Suspect Yes D. Acute Toxicity: Eye Contact Irritation, discharge, swelling of eyelids Skin Contact: Irritant, acne-like rash, pustules Inhalation: Irritation to nose, throat & lungs, nausea, vomiting, anorexia, jaundice, edema, abdominal pain, fatigue, dark urine. E. Chronic Toxicity: Target Organs: liver, eyes, skin, reproduct. effects Long-Term Effects: suspect carcinogen, chloracne, pigmentation (skin, nails) Exposure Limits A. OSHA PEL: 0.5 mg/m³ (TWA) B. ACGIH TLV: 0.5 mg/m³ (TWA) B. ACGIH TLV: 0.5 mg/m³ (TWA) C. IDLH: 5 mg/m³ D. NIOSH REL: 0.001 mg/m³ (10-hr. TWA) E. STEL:
VI.	Other Pertinent Information/SpecialPrecautions: Can persist in tissues for years after exposure stops. Aroclor 1248 (48% Chlorine) - exposure limits as for Aroclor 1254 Aroclor 1242 (42% Chlorine) - OSHA PEL - 1.0 mg/m³ (TWA); ACGIH - 1.0 mg/m³ (TWA)
VII.	Reference Section
.,,	ACGIH TLVs and BEIs 1996
•	Code of Federal Regulations 1995
	NIOSH Pocket Guide to Chemical Hazards 1994

Date: 2/8/90 Update: 3/97 #39

CHEMICAL DATA SHEET

I.	Chemical/CompoundName: Lead, inorganic, as dust					
	A. Synonyms: Pb, solder, dross, Plumbum					
	B. CAS #:7439-92-1					
	C. Formula: Pb					
П.	Physical Characteristics					
	A Liquid X Solid Powder Gas					
	B. Color: Silvery to gray, depending upon oxidation, heavy ductile					
	C. Odor: Varies with compound					
	D. LEL - Dust may be explosive Flash Pt. N/A					
	E. Boiling Point 3164°F Melting Point 621°F					
	Ionization Potential: N/A Vapor Pressure: 0 mm					
	F. Other:					
Ш.	Recommended Air Purifying Cartridge:					
	X Dusts, Fumes, MistsAcid Gases					
	Organic VaporsPesticides					
	X HEPAAir Purifying is Inappropriate					
	Ammonia/AminesOther:					
IV.	Health Hazards Data					
	A. Routes of Entry: X Inhalation X Skin Absorption X Ingestion Skin/Eye Contact					
	B. Human Carcinogen: X No Not Enough Data Suspect Yes					
	Classifying Agency:NIOSHACGIHOSHA					
	C. Sensitizer:No _X No DataSuspectYes					
	D. Acute Toxicity:					
	Eye Contact: Dust is irritant.					
	Skin Contact: Molten lead causes burns. Generally, in solid state lead causes no					
	acute symptoms.					
	Inhalation: Lassitude, insomnia, weakness, GI distrubances, colic.					
	E. Chronic Toxicity:					
	Target Organs: CNS, blood, GI tract, kidneys, gingival tissue, eyes.					
	Long-Term Effects: Anorexia, weight loss, constipation, pallor, neuro-muscular					
	motor weakness, "wrist drop". A suspect carcinogen of the					
	lungs and kidneys. An experimental teratogen, anemia,					
	gingival lead line.					
V.	Exposure Limits					
	A. OSHA PEL: <u>0.05 mg/m³ TWA</u>					
	B. ACGIH TLV: 0.15 mg/m ³ TWA					
	C. IDLH: 100 mg/m ³ as Pb					
	D. NIOSH REL: <0.1 mg/m ³ 10 hr. TWA					
	E. STEL:					
VI.	Other Pertinent Information/SpecialPrecautions:					
VII	Reference Section					
	ACGIH TLVs and BEIs 1996					
	Code of Federal Regulations 1996					
	NIOSH Pocket Guide to Chemical Hazards 1994					

Date: 8/90 Update: 3/97

#76

CHEMICAL DATA SHEET

Chemical/CompoundName: Coal tar pitch volatiles (benzene soluble fraction)					
A. Synonyms: anthracene, BaP, phenanthrene, acridine, crysene, pyrene, carbozole, PNA's					
B. CAS #: 65996-93-2					
C. Formula:					
II. Physical Characteristics					
A. Liquid X Solid Powder Gas					
B. Color: Colorless/pale green/bright yellow, black or dark brown amorphous residue.					
C. Odor: faint aromatic					
D. LEL % Flash Pt. °F					
E. Boiling Point °F Melting Point °F					
Ionization Potential: Vapor Pressure: 0mm					
F. Other:					
III. Recommended Air Purifying Cartridge:					
X Dusts, Fumes, MistsAcid Gases					
_X_Organic VaporsPesticides					
X HEPA Air Purifying is Inappropriate					
Ammonia/AminesOther:					
\cdot					
IV. Health Hazards Data					
A. Routes of Entry: X Inhalation X Skin Absorption Ingestion X Skin/Eye Contact					
B. Human Carcinogen: No Not Enough Data SuspectX Yes					
Classifying Agency: X_NIOSH X_ACGIHOSHA					
C. Sensitizer:NoNo Data X_SuspectYes					
D. Acute Toxicity:					
Eye Contact: irritant-tearing; swelling and redness of eyelids					
Skin Contact: Acne folliculitis, contact dermatitis, allergic skin rash, may cause					
photosentitization					
Inhalation: Chronic bronchitis	_				
E. Chronic Toxicity:					
Target Organs: Skin, respiratory system, kidneys, liver, bladder					
Long-Term Effects: Exposure to PNA's associated with increased incidence of					
lung, bladder, kidney, and skin cancer					
V. Exposure Limits					
A. OSHA PEL: 0.2 mg/m³ (TWA)					
B. ACGIH TLV: 0.2 mg/m ³ (TWA)					
C. IDLH: 80 mg/m ³					
D. NIOSH REL: <u>0.1 mg/m³ (10-hr. TWA)</u>					
E. STEL:					

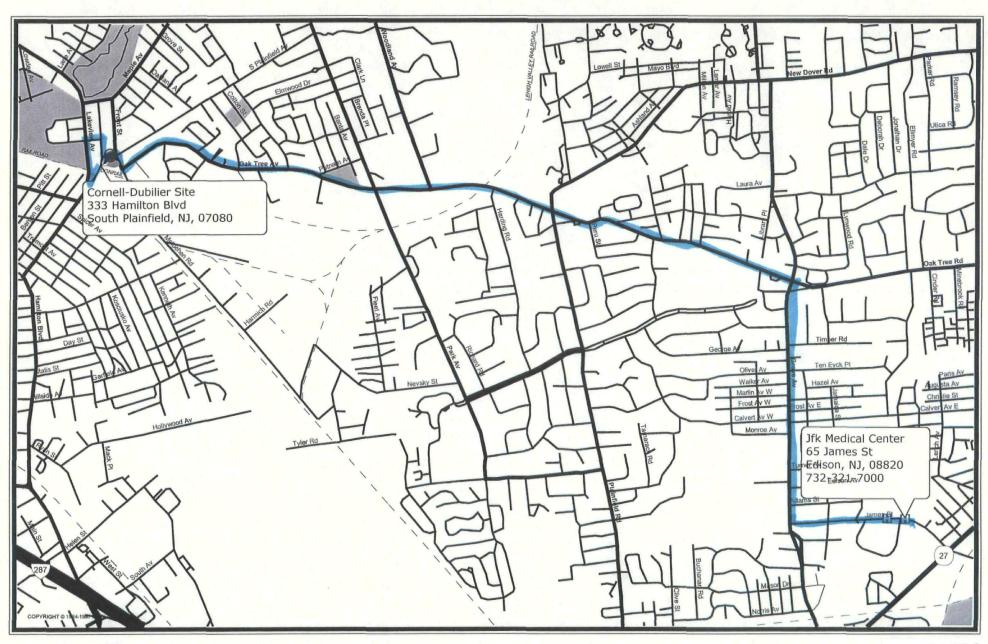
VI. Other Pertinent Information/Special Precautions: PNA's may be associated with benzene, an agent suspected of causing leukemia and known to cause aplastic anemia. Personnel exposed or suspect of being exposed to these compounds therefore, should receive a complete blood count as part of their medical surveillance exam.

VII. Reference Section

ACGIH TLVs and BEIs 1996 Code of Federal Regulations 1995 NIOSH Pocket Guide to Chemical Hazards 1994

APPENDIX C HOSPITAL ROUTE MAP AND DIRECTIONS

Hospital Route Map



300580

ROAD TRIPS Door-to-Door™

333 Hamilton Blvd, South Plainfield, NJ to 65 James St, Edison, NJ

5.0 Miles; ~15 Minute(s)

Quickest Route

Driving Directions	Trip Odometer	Drive Time
Start at 333 Hamilton Blvd, South Plainfield, NJ		
Start on Hamilton Boulevard Drive less than 0.1 miles	0.0	0:00
Make a sharp right on Lakeview Avenue Drive 0.2 miles (~ 4 blocks)	0.2	0:01
Turn right on Church Street Drive less than 0.1 miles (~ 1 block)	0.3	0:01
Turn right on Hamilton Boulevard Drive 0.1 miles (~ 1 block)	0.4	0:01
Turn left on South Plainfield Avenue Drive less than 0.1 miles (~ 1 block)	0.4	0:01
Turn right on Front Street Drive less than 0.1 miles (~ 1 block)	0.5	0:01
Turn left on Oak Tree Avenue Drive 1.3 miles (~4 mins)	1.8	0:05
Road name changes to Oak Tree Road Drive 1.6 miles (~5 mins)	3.4	0:10
Turn right on Grove Avenue Drive 1.0 miles (~3 mins)	4.4	0:13
Turn left on James Street Drive 0.6 miles (~2 mins)	5.0	0:15
End at 65 James St, Edison, NJ	5.0	0:15

© 1996-1998 TravRoute® Software.
All drive times are approximate.
("~5 mins' indicates you should be on this segment for 'about 5 minutes'.)

This suggested route is based on various data sources and may be incomplete or inaccurate in some cases. The user assumes full liability for any delay, loss, or damage which may occur as a result of its use. Please obey local traffic laws.

APPENDIX D ACTIVITY HAZARD ANALYSES

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund	·	
Phase of Work	Page 1 of 2	Analysis Approved by
Mobilization/Demob.		Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROLMEASURES
Mobilization and demobilization of	Slips/trips/falls	Maintain alertness to slip/trip/fall hazards;Maintain good housekeeping;
equipment site		Personnel will use caution when working on
tools, personnel		slopes, plastic, wet or muddy areas; or oily areas;
		Walk, do not run; and
		Wear footwear with soles that grip.
2. Set up/remove	Manual lifting and	Use proper lifting techniques; and
staging and	material handling	Team lifting will be used for heavy loads or use
decontamination		mechanical lifting devices.
areas		<u> </u>
	Temperature	Drink plenty of fluids: The improvement of the standard
	extremes	Train personnel of signs/symptoms of heat/cold
		stress;Monitor air temperatures when extreme weather
		conditions are present;
		Stay in visual and verbal contact with your buddy;
		and
		Use Temperature Extremes program (Appendix
		F).
	Hand tool usage	Daily inspections will be performed;
		Remove broken or damaged tools from service;
		Use the tool for its intended purpose; and
		Use in accordance with manufacturer instructions.
	Back Injuries	Follow proper lifting techniques: lift with legs,
		keep load close to the body, do not bend or twist
		with load, test load prior to lift, get help for heavy
		or awkward loads, clear path.
		Site personnel will be instructed on proper lifting
		techniques; mechanical devices should be used to
		reduce manual handling of materials; team lifting
		should be utilized if mechanical devices are not
	Vohioulan Tareffi -	available.
	Vehicular Traffic	Spotters will be used when backing up trucks and
<u> </u>	· · · · · · · · · · · · · · · · · · ·	heavy equipment and when moving equipment.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		
Phase of Work	Page 2 of 2	Analysis Approved by
Mobilization/Demob.		Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
	Overhead Hazards	 Personnel will be required to wear hard hats that meet ANSI Standard Z89.1. All ground personnel will stay clear of suspended loads. All equipment will be provided with guards,
		 canopies or grills to protect the operator from falling or flying objects. All overhead hazards will be identified prior to commencing work operations.
	Noise	Ear plugs or ear muffs.
	Dropped Objects	Steel toe boots meeting ANSI Standard Z41 will be worn.
	Eye Injuries	Safety glasses meeting ANSI Standard Z87 will be worn.
	Fire/Explosion	ABC type fire extinguishers shall be readily available; no smoking in work area.
	Electrocution	 Equipment will be equipped with GFCI. All electrical work will be conducted by a licensed electrician. All equipment will stay a minimum of 15 feet from overhead energized electrical lines (50 kV). This distance will increase .4 inches for each 1 kV above 50 kV.
	Pinch/Cut/Smash	 Cut resistant kevlar work gloves will be worn when dealing with sharp objects; All hand and power tools will be maintained in safe condition; and Guards will be kept in place while using hand and power tools.
	Biological hazards	 Be alert to the presence of biological hazards; Wear insect repellent; Follow procedures in Section 4.4.2 for tick bites; ESS should be aware of on-site personnel with allergic reactions in insect bites and stings.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund	20441 I IMIIII 1014, 11J	
Phase of Work	Page 1 of 2	Analysis Approved by
Drilling Operations	2 4 5 2 5 2	Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
1. Drilling Operations	Chemical	Wear appropriate PPE per Table 6-1;
including well		• Perform air monitoring per Tables 7-1 and 7-2;
installation,		Practice contamination avoidance;
hydraulic testing,		Follow proper decontamination procedures; and
and soil borings.		Wash hands/face before eating, drinking or smoking.
	Hand and Power	Equip all electrical equipment with GFCI's;
	Tool Use	Inspect all electrical equipment and tools prior to
		use;
		Daily inspections will be performed;
		Remove broken or damaged tools from service;
		Use the tool for its intended purpose;
		Use in accordance with manufacturer instructions;
	,	and
		Tag and remove defective equipment;
,	Temperature	Drink plenty of fluids:
	extremes	Train personnel of signs/symptoms of heat/cold
		stress;
		Monitor air temperatures when extreme weather
		conditions are present;
		Stay in visual and verbal contact with your buddy;
		and
		Use Temperature Extremes program (Appendix F).
	Back Injuries	Follow proper lifting techniques: lift with legs, keep
		load close to the body, do not bend or twist with
		load, test load prior to lift, get help for heavy or
		awkward loads, clear path.
		Site personnel will be instructed on proper lifting
		techniques; mechanical devices should be used to
		reduce manual handling of materials; team lifting
		should be utilized if mechanical devices are not
	V 1: 1 70 cc	available.
	Vehicular Traffic	Spotters will be used when backing up trucks and
·	0 1 177 1	heavy equipment and when moving equipment.
	Overhead Hazards	Personnel will be required to wear hard hats that
		meet ANSI Standard Z89.1. All ground personnel
		will stay clear of suspended loads. All equipment
		will be provided with guards, canopies or grills to
·		protect the operator from falling or flying objects.
		All overhead hazards will be identified prior to
		commencing work operations.
		l

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund	,	
Phase of Work	Page 2 of 2	Analysis Approved by
Drilling Operations		Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
	Dropped Objects	Steel toe boots meeting ANSI Standard Z41 will be worn.
	Eye Injuries	Safety glasses meeting ANSI Standard Z87 will be worn.
	Fire/Explosion	ABC type fire extinguishers shall be readily available; no smoking in work area.
	Pinch/Cut/Smash	• Cut resistant kevlar work gloves will be worn when dealing with sharp objects; all hand and power tools will be maintained in safe condition; guards will be kept in place while using hand and power tools.
	Biological hazards	 Be alert to the presence of biological hazards; Wear insect repellent; Follow procedures in Section 4.4.2 for tick bites; ESS should be aware of on-site personnel with allergic reactions in insect bites and stings.
	Heavy Equipment	Ground personnel will stay clear of all suspended loads;
		 Spill and absorbent materials will be readily available; drip pans, polyethylene sheeting or other means will be used for secondary containment; Ground personnel will stay out of the swing radius; Eye contact with operators will be made before approaching equipment; Equipment will not be approached on blind sides; all equipment will be equipped with backup alarms.
	Slips/Trips/Falls	 Maintain alertness to slip/trip/fall hazards; Maintain good housekeeping;
		 Personnel will use caution when working on slopes, plastic, wet or muddy areas; or oily areas; Walk, do not run; and Wear footwear with soles that grip.
<u></u>	Noise	• Ear plugs or ear muffs for all jackhammer use.

Project Identification Cornell-Dubilier	Location South Plainfield, NJ	Estimated Dates 1999
Electronics Superfund	South Flammeld, NJ	1777
Phase of Work	Page 1 of 2	Analysis Approved by
Excavation and		Joseph L. Sbarra, CIH
Operations		
TASKS	HAZARDS	CONTROL MEASURES
 Excavation of 	Chemical	Wear appropriate PPE per Table 6-1;
test pits.		• Perform air monitoring per Tables 7-1 and 7-2;
		Practice contamination avoidance;
		Follow proper decontamination procedures; and
		 Wash hands/face before eating, drinking or smoking.
	Slips/trips/falls	Maintain alertness to slip/trip/fall hazards;
	Supor unportante	Maintain good housekeeping;
		Personnel will use caution when working on
		slopes, plastic, wet or muddy areas; or oily areas;
		Walk, do not run; and
		Wear footwear with soles that grip.
	Manual lifting and	Use proper lifting techniques; and
	material handling	Team lifting will be used for heavy loads or use
		mechanical lifting devices.
	Temperature	Drink plenty of fluids:
	extremes	Train personnel of signs/symptoms of heat/cold stress;
		Monitor air temperatures when extreme weather
		conditions are present;
		Stay in visual and verbal contact with your byddy, and
		buddy; andUse Temperature Extremes program (Appendix
		F).
	Hand tool usage	Daily inspections will be performed;
		Remove broken or damaged tools from service;
	!	Use the tool for its intended purpose; and
		Use in accordance with manufacturer
		instructions.
	Back Injuries	• Follow proper lifting techniques: lift with legs,
		keep load close to the body, do not bend or twist
		with load, test load prior to lift, get help for
		heavy or awkward loads, clear path.
		Site personnel will be instructed on proper lifting
		techniques; mechanical devices should be used
		to reduce manual handling of materials; team
		lifting should be utilized if mechanical devices
L		are not available.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund	ŕ	
Phase of Work	Page 2 of 2	Analysis Approved by
Excavation and	o o	Joseph L. Sbarra, CIH
Operations		•
TASKS	HAZARDS	CONTROL MEASURES
	Vehicular Traffic	Spotters will be used when backing up trucks
		and heavy equipment and when moving
		equipment.
	Overhead Hazards	 Personnel will be required to wear hard hats that
		meet ANSI Standard Z89.1;
		All ground personnel will stay clear of
		suspended loads;
	,	All equipment will be provided with guards,
		canopies or grills to protect the operator from
		falling or flying objects; and
1		All overhead hazards will be identified prior to
	•	commencing work operations.
	Noise	Ear plugs or ear muffs.
	Eye Injuries	Safety glasses meeting ANSI Standard Z87 will
		be worn.
	Fire/Explosion	ABC type fire extinguishers shall be readily
		available;
		and no smoking in work area.
	Electrocution	Equipment will be equipped with GFCI;
·		All electrical work will be conducted by a
		licensed electrician;
		All equipment will stay a minimum of 15 feet
		from overhead energized electrical lines (50 kV).
		This distance will increase .4 inches for each 1
		kV above 50 kV.
	Pinch/Cut/Smash	Cut resistant kevlar work gloves will be worn
		when dealing with sharp objects;
		All hand and power tools will be maintained in
		safe condition; and
		Guards will be kept in place while using hand
	D: 1 : 1:	and power tools.
	Biological hazards	Be alert to the presence of biological hazards;
		• Wear insect repellent;
		• Follow procedures in Section 4.4.2 for tick bites;
		ESS should be aware of on-site personnel with
		allergic reactions in insect bites and stings.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		
Phase of Work	Page 1 of 2	Analysis Approved by
Groundwater Sampling		Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
1. Groundwater	Chemical	Wear appropriate PPE per Table 6-1;
Sampling.		Practice contamination avoidance;
		Follow proper decontamination procedures; and
		Wash hands/face before eating, drinking or
		smoking.
	Injury/exposure of	PPE and air monitoring as per the EHS Plan;
	worker's eyes, face,	Proper operation of each type of system (i.e.
	hands, skin due to	hookup, pressure regulation, flowrate and work
	pressure, bursting of	practices) by an experience pump operator (e.g.
	lines and backspray	plastic sheeting); and
	during pumping	Use splashshield around pressure hookups to
	D 1	minimize worker exposure to groundwater/oil.
	Releases	Place all liquid transfer equipment on double-lined
		plastic areas during work with a bermed area
	Tomoromotives	according to the work plan.
	Temperature	Drink plenty of fluids:Train personnel of signs/symptoms of heat/cold
	extremes	stress;
		Monitor air temperatures when extreme weather
		conditions are present;
		Stay in visual and verbal contact with your buddy;
		and
		Use Temperature Extremes program (Appendix F).
	Back Injuries	Follow proper lifting techniques: lift with legs,
		keep load close to the body, do not bend or twist
		with load, test load prior to lift, get help for heavy
		or awkward loads, clear path.
		Site personnel will be instructed on proper lifting
		techniques; mechanical devices should be used to
		reduce manual handling of materials; team lifting
		should be utilized if mechanical devices are not
		available.
	Dropped Objects	Steel toe boots meeting ANSI Standard Z41 will
	D: 1/C //C	be worn.
	Pinch/Cut/Smash	Cut resistant kevlar work gloves will be worn
		when dealing with sharp objects;
	•	All hand and power tools will be maintained in
		safe condition; and
		Guards will be kept in place while using hand and power tools.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		
Phase of Work	Page 2 of 2	Analysis Approved by
Groundwater Sampling		Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
	Biological hazards	Be alert to the presence of biological hazards;
		Wear insect repellent;
		• Follow procedures in Section 4.4.2 for tick bites;
		ESS should be aware of on-site personnel with
		allergic reactions in insect bites and stings.
	Hand and Power	Equip all electrical equipment with GFCI's;
	Tool Use	Inspect all electrical equipment and tools prior to
		use;
		Daily inspections will be performed;
		 Remove broken or damaged tools from service;
		• Use the tool for its intended purpose;
·		• Use in accordance with manufacturer instructions;
	•	and
		 Tag and remove defective equipment;
	Slips, trips, and falls	 Maintain alertness to slip/trip/fall hazards;
		 Maintain good housekeeping;
		 Personnel will use caution when working on
		slopes, plastic, wet or muddy areas; or oily areas;
		Walk, do not run; and
		• Wear footwear with soles that grip.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		2000
Phase of Work	Page 1 of 1	Analysis Approved by
Surface Soil Sampling	, g	Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
On- and off-site surface soil sampling.	Chemical	 Wear appropriate PPE per Table 6-1; Practice contamination avoidance; Follow proper decontamination procedures; and Wash hands/face before eating, drinking or smoking.
	Spills	Setup system and drum containment pad according to the work plan.
	Slips, trips, and falls	 Maintain alertness to slip/trip/fall hazards; Maintain good housekeeping; Personnel will use caution when working on slopes, plastic, wet or muddy areas; or oily areas; Walk, do not run; and Wear footwear with soles that grip.
	Back Injuries	 Follow proper lifting techniques: lift with legs, keep load close to the body, do not bend or twist with load, test load prior to lift, get help for heavy or awkward loads, clear path. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	Dropped Objects	Steel toe boots meeting ANSI Standard Z41 will be worn.
	Pinch/Cut/Smash	 Cut resistant kevlar work gloves will be worn when dealing with sharp objects; All hand and power tools will be maintained in safe condition; Guards will be kept in place while using hand and power tools.
	Biological hazards	 Be alert to the presence of biological hazards; Wear insect repellent; Follow procedures in Section 4.4.2 for tick bites; ESS should be aware of on-site personnel with allergic reactions in insect bites and stings.
	Temperature extremes	 Drink plenty of fluids: Train personnel of signs/symptoms of heat/cold stress; Monitor air temperatures when extreme weather conditions are present; Stay in visual and verbal contact with your buddy; and Use Temperature Extremes program (Appendix F).

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999 .
Electronics Superfund		
Phase of Work	Page 1 of 2	Analysis Approved by
Surface Water and	-	Joseph L. Sbarra, CIH
Sediment Sampling		
TASKS	HAZARDS	CONTROL MEASURES
Surface Water and	Chemical	• Wear appropriate PPE per Table 6-1;
Sediment		Practice contamination avoidance;
Sampling.		 Follow proper decontamination procedures; and
		Wash hands/face before eating, drinking or smoking.
	Struck	An experienced operator will set up all pumping
	by/electrocution	equipment according to manufacturers' guidelines;
	during system use	and
		Use a GFCI for pump system, keep cords out of
		water and/or product.
	Spills	Setup system and drum containment pad according
		to the work plan.
	Releases	Place all liquid transfer equipment on double-lined
		plastic areas during work with a bermed area
		according to the work plan.
	Back Injuries	 Do not overexert when using sampling tools;
		• Follow proper lifting techniques: lift with legs,
		keep load close to the body, do not bend or twist
		with load, test load prior to lift, get help for heavy
		or awkward loads, clear path; and
		Site personnel will be instructed on proper lifting techniques: machanical devices should be used to
		techniques; mechanical devices should be used to reduce manual handling of materials; team lifting
		should be utilized if mechanical devices are not
		available.
	Dropped Objects	Steel toe boots meeting ANSI Standard Z41 will
	11	be worn.
	Pinch/Cut/Smash	Cut resistant kevlar work gloves will be worn
·		when dealing with sharp objects;
		All hand and power tools will be maintained in
		safe condition; and
		Guards will be kept in place while using hand and
		power tools.
	Biological hazards	Be alert to the presence of biological hazards;
		Wear insect repellent;
		• Follow procedures in Section 4.4.2 for tick bites;
		ESS should be aware of on-site personnel with
		allergic reactions in insect bites and stings.

Project Identification	Location	Estimated Dates
Project Identification		
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		'
Phase of Work	Page 2 of 2	Analysis Approved by
Surface Water and		Joseph L. Sbarra, CIH
Sediment Sampling	·	-
TASKS	HAZARDS	CONTROL MEASURES
	Slips, trips, and	Maintain alertness to slip/trip/fall hazards;
	falls	Maintain good housekeeping;
1		Personnel will use caution when working on
		slopes, plastic, wet or muddy areas; or oily areas;
	ł	Walk, do not run; and
		Wear footwear with soles that grip.
	Eye Injuries	Safety glasses meeting ANSI Standard Z87 will be worn.
	Temperature	Drink plenty of fluids:
	extremes	Train personnel of signs/symptoms of heat/cold stress;
		Monitor air temperatures when extreme weather conditions are present;
,		 Stay in visual and verbal contact with your buddy; and
		Use Temperature Extremes Program (Appendix F).

Project Identification Cornell-Dubilier	Location South Plainfield, NJ	Estimated Dates 1999
Electronics Superfund	South Plainfield, NJ	1999
Phase of Work Building, Debris, and/or Wipe Samples	Page 1 of 2	Analysis Approved by Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
Building, Debris, and/or Wipe Samples.	Chemical	 Wear appropriate PPE per Table 6-1; Practice contamination avoidance; Follow proper decontamination procedures; and Wash hands/face before eating, drinking or smoking.
·	Slips, trips, and falls	 Maintain alertness to slip/trip/fall hazards; Maintain good housekeeping; Personnel will use caution when working on slopes, plastic, wet or muddy areas; or oily areas; Walk, do not run; and Wear footwear with soles that grip.
	Noise	Ear plugs or ear muffs.
	Dropped Objects	Steel toe boots meeting ANSI Standard Z41 will be worn.
	Eye Injuries	Safety glasses meeting ANSI Standard Z87 will be worn.
	Fire/Explosion	ABC type fire extinguishers shall be readily available; no smoking in work area.
	Back Injuries	 Follow proper lifting techniques: lift with legs, keep load close to the body, do not bend or twist with load, test load prior to lift, get help for heavy or awkward loads, clear path. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	Pinch/Cut/Smash	 Cut resistant kevlar work gloves will be worn when dealing with sharp objects; All hand and power tools will be maintained in safe condition; Guards will be kept in place while using hand and power tools.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund	1	
Phase of Work	Page 2 of 2	Analysis Approved by
Building, Debris,		Joseph L. Sbarra, CIH
and/or Wipe Samples		
TASKS	HAZARDS	CONTROL MEASURES
	Hand and Power	Equip all electrical equipment with GFCI's;
	Tools	 Inspect all electrical equipment and tools prior to use;
		Daily inspections will be performed;
		Remove broken or damaged tools from service;
		Use the tool for its intended purpose;
		Use in accordance with manufacturer instructions;
		and
		Tag and remove defective equipment;
	Spills	Setup system and drum containment pad according to the work plan.
	Temperature	Drink plenty of fluids:
	extremes	Train personnel of signs/symptoms of heat/cold
		stress;
		Monitor air temperatures when extreme weather
·		conditions are present;
		 Stay in visual and verbal contact with your buddy;
		and
		• Use Temperature Extremes Program (Appendix F).

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		1377
Phase of Work	Page 1 of 1	Analysis Approved by
Wetlands Survey	1 age 1 of 1	Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
1. Delineation of	Chemical	Wear appropriate PPE per Table 6-1;
wetland/ecological	Chemical	Practice contamination avoidance;
areas.		Follow proper decontamination procedures; and
arous.		Wash hands/face before eating, drinking or
		smoking.
	Back Injuries	Follow proper lifting techniques: lift with legs,
	2001 21,01100	keep load close to the body, do not bend or twist
		with load, test load prior to lift, get help for heavy
		or awkward loads, clear path.
		Site personnel will be instructed on proper lifting
		techniques; mechanical devices should be used to
		reduce manual handling of materials; team lifting
	·.	should be utilized if mechanical devices are not
		available.
	Eye Injuries	Safety glasses meeting ANSI Standard Z87 will be
		worn.
	Slips/trips/falls	Maintain alertness to slip/trip/fall hazards;
		 Personnel will use caution when working on
		slopes, plastic, wet or muddy areas, or oily areas.
		Maintain good housekeeping; and
		Wear footwear with soles that grip.
	Biological hazards	Be alert to the presence of biological hazards;
		Wear insect repellent;
		• Follow procedures in Section 4.4.2 for tick bites;
		ESS should be aware of on-site personnel with
		allergic reactions in insect bites and stings.
	Temperature	Drink plenty of fluids:
	extremes	Train personnel of signs/symptoms of heat stress;
		Monitor air temperatures when extreme weather
		conditions are present;
		Stay in visual and verbal contact with your buddy;
,		and
		• Use Temperature Extremes Program (Appendix F).

Project Identification Cornell-Dubilier Electronics Superfund	Location South Plainfield, NJ	Estimated Dates 1999
Phase of Work Geophysical Survey	Page 1 of 1	Analysis Approved by Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
Geophysical survey including magneto-meter and electromagnetic.	Chemical	 Wear appropriate PPE per Table 6-1; Practice contamination avoidance; Follow proper decontamination procedures; and Wash hands/face before eating, drinking or smoking.
	Temperature extremes	 Drink plenty of fluids: Train personnel of signs/symptoms of heat/cold stress; Monitor air temperatures when extreme weather conditions are present; Stay in visual and verbal contact with your buddy; and Use Temperature Extremes program (Appendix F).
	Back Injuries	 Follow proper lifting techniques: lift with legs, keep load close to the body, do not bend or twist with load, test load prior to lift, get help for heavy or awkward loads, clear path. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	Biological hazards	 Be alert to the presence of biological hazards; Wear insect repellent; Follow procedures in Section 4.4.2 for tick bites; ESS should be aware of on-site personnel with allergic reactions in insect bites and stings.
	Eye Injuries	Safety glasses meeting ANSI Standard Z87 will be worn.
	Slips/Trips/Falls	 Maintain alertness to slip/trip/fall hazards; Maintain good housekeeping; Personnel will use caution when working on slopes, plastic, wet or muddy areas; or oily areas; Walk, do not run; and Wear footwear with soles that grip.

Project Identification Cornell-Dubilier	Location South Plainfield, NJ	Estimated Dates 1999
Phase of Work IDW Characterization and Disposal	Page 1 of 2	Analysis Approved by Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
IDW Character- ization and Disposal.	Chemical	 Wear appropriate PPE per Table 6-1; Practice contamination avoidance; Follow proper decontamination procedures; and Wash hands/face before eating, drinking or smoking.
	Temperature extremes	 Drink plenty of fluids: Train personnel of signs/symptoms of heat stress; Monitor air temperatures when extreme weather conditions are present; Stay in visual and verbal contact with your buddy; and Use Temperature Extremes Program (Appendix F).
	Back Injuries	 Do not overexert when using sampling tools; and Follow proper lifting techniques: lift with legs, keep load close to the body, do not bend or twist with load, test load prior to lift, get help for heavy or awkward loads, clear path. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	Vehicular Traffic	Spotters will be used when backing up trucks and heavy equipment and when moving equipment.
	Dropped Objects	Steel toe boots meeting ANSI Standard Z41 will be worn.
	Eye Injuries	Safety glasses meeting ANSI Standard Z87 will be worn.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		,
Phase of Work	Page 2 of 2	Analysis Approved by
IDW Characterization		Joseph L. Sbarra, CIH
and Disposal		
TASKS	HAZARDS	CONTROL MEASURES
	Heavy Equipment	Ground personnel will stay clear of all suspended
		loads;
		Spill and absorbent materials will be readily
		available; drip pans, polyethylene sheeting or
		other means will be used for secondary containment;
		Ground personnel will stay out of the swing radius;
		Eye contact with operators will be made before approaching equipment;
		Equipment will not be approached on blind sides; and
		All equipment will be equipped with backup alarms.
	Slips/Trips/Falls	Maintain alertness to slip/trip/fall hazards;
	Supartipart and	Maintain good housekeeping;
		Personnel will use caution when working on
		slopes, plastic, wet or muddy areas; or oily areas;
		Walk, do not run; and
		Wear footwear with soles that grip.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		
Phase of Work	Page 1 of 2	Analysis Approved by
Decontamination		Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
Decontaminate personnel.	Chemical	 Wear appropriate PPE per Table 6-1; Practice contamination avoidance;
Decontaminate heavy equipment.		 Follow proper decontamination procedures; and Wash hands/face before eating, drinking or smoking.
3. Steam cleaning.	Steam/Heat/Splashing Back Injuries	 Use face shield and safety glasses or goggles; Stay out of the splash/steam radius; Do not direct steam at anyone; Do not hold objects with your foot or hands and steam area near it; Ensure that direction of spray minimizes spread of constituents of concern; Use shielding as necessary; Pressure washer will be equipped with a dead man's switch; and Use wand extenders. Follow proper lifting techniques: lift with legs,
	,	 keep load close to the body, do not bend or twist with load, test load prior to lift, get help for heavy or awkward loads, clear path. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	Vehicular Traffic	 Spotters will be used when backing up trucks and heavy equipment and when moving equipment.
	Noise	Ear plugs or ear muffs.
	Dropped Objects	 Steel toe boots meeting ANSI Standard Z41 will be worn.
	Eye Injuries	• Safety glasses meeting ANSI Standard Z87 will be worn.
	Fire/Explosion	ABC type fire extinguishers shall be readily available; no smoking in work area.

Project Identification	Location	Estimated Dates
Cornell-Dubilier	South Plainfield, NJ	1999
Electronics Superfund		
Phase of Work	Page 2 of 2	Analysis Approved by
Decontamination		Joseph L. Sbarra, CIH
TASKS	HAZARDS	CONTROL MEASURES
	Pinch/Cut/Smash	Cut resistant kevlar work gloves will be worn when dealing with sharp objects;
		All hand and power tools will be maintained in safe condition;
		Guards will be kept in place while using hand and power tools.
	Slips/trips/falls	 Maintain alertness to slip/trip/fall hazards; Maintain good housekeeping; Personnel will use caution when working on slopes, plastic, wet or muddy areas; or oily areas;
		Walk, do not run; andWear footwear with soles that grip.
	Biological hazards	 Be alert to the presence of biological hazards; Wear insect repellent; Follow procedures in Section 4.4.2 for tick bites; ESS should be aware of on-site personnel with allergic reactions in insect bites and stings.
	Temperature extremes	 Drink plenty of fluids: Train personnel of signs/symptoms of heat stress; Monitor air temperatures when extreme weather conditions are present; Stay in visual and verbal contact with your buddy; and Use Temperature Extremes Program (Appendix F).

Project Identification Cornell-Dubilier Electronics Superfund	Location South Plainfield, NJ	Estimated Dates 1999
Phase of Work Decontamination	Page 1 of 1	Analysis Approved by Joseph L. Sbarra, CIH
TASKS Dye Testing	HAZARDS Chemical	 CONTROL MEASURES Wear appropriate PPE per Table 6-1; Conduct hazard communication training for dye to be used; Wash hands/face before eating, drinking or smoking
	Slips/trips/falls	 Maintain alertness to slip/trip/fall hazards; Maintain good housekeeping; Personnel will use caution when working on slopes, plastic, wet or muddy areas; or oily areas; Walk, do not run; and Wear footwear with soles that grip.
	Eye Injuries	 Safety glasses meeting ANSI Standard Z87 will be worn.

APPENDIX E

EHS FORMS

FOSTER WHEELER FOSTER WHEELER ENVIRONMENTAL CORPORATION

MEDICAL DATA SHEET

The brief medical data sheet shall be completed by all on-site personnel and will be kept in the Support Zone by the ESS as a project record during the conduct of site operations. It accompanies any personnel when medical assistance is needed or if transport to a hospital is required.

Project:			
			ne Telephone:
Address:			
Age:	Height	Weight	Blood Type
Drug or Othe	r Allergies:		
Particular Ser	sitivities:	100	
Do You Wear	r Contacts?		
Provide A Ch	eck List Of Previous Illne	esses:	
What Medica	tions Are You Presently U	Jsing?	
Name, Addre	ss, And Phone Number O	f Personal Physician:	

FOSTER WHEELER ENVIRONMENTAL CORPORATION

WEEKLY HEALTH AND SAFETY REPORT

Project Name:	
Location:	
Delivery Order No.	
SITE INFORMATION	INJURIES AND ILLNESSES
Week Ending	Yes No
Hours Worked	Describe and attach reports:
Level of Protection B _ C _ D _	
MAJOR ACTIVITIES CONDUCTED THIS (drum handling, sampling, excavation, abatement/T&D, etc.)	WEEK:
SIGNIFICANT EVENTS THIS WEEK:	
(regulatory visits, equipment malfunctions, process start-up or s	hutdown):
FUTURE ISSUES: (schedule, manpower allocation, monitoring equipment, other re	esources needed)
SITE AUDIT/INSPECTIONS CONDUCTED	Yes No
(describe outstanding findings and attach results)	

AIR MONITO	ORING:			<u></u>					
Major		•		Worker		FID/PID	CGI/O2	PDM	
Activity	Activity Location(s)			Occupatio	n	Range	Range	Range	Other
PERSONAL.	AIR MO	ONITORING							
Analyte	Activ	ity Monitored	0	Occupation		Location	R	esult	Type of Sample*
SUBCONTRA	ACTOR	S ON SITE							
	Company	y Name		 	Task or l	Function		rn to Site Veek (Y/N)	
Health and Sa	afety Off	ficer - Signatu	re		Date				

000

TABLE 6-1 PERSONAL PROTECTIVE EQUIPMENT SELECTION

TASK	HEAD	EYE/FACE	FEET	HANDS	BODY	HEARING	RESPIRATOR
		100					
		·					
_							
				,			
,							
			_				



FOSTER WHEELER ENVIRONMENTAL CORPORATION GENERAL HEALTH AND SAFETY RULES

- 1. All site personnel must attend each day's Daily Briefing.
- 2. Any individual taking prescribed drugs shall inform the FOL/ESS of the type of medication. The FOL/ESS will review the matter with the PHSM and the Corporate Medical Consultant (CMC), who will decide if the employee can safely work on-site while taking the medication.
- 3. The personal protective equipment specified by the FOL/ESS and in the EHS plan(s) shall be worn by all site personnel. This includes hard hats and safety glasses which must be worn at all times in active work areas.
- 4. Facial hair (beards, long sideburns or mustaches) which may interfere with a satisfactory fit of a respirator mask is not allowed on any person who may be required to wear a respirator.
- 5. All personnel must sign the site log and the exclusion zone log when used at the site.
- 6. Personnel must follow proper decontamination procedures and shower at the end of the work shift.
- 7. Eating, drinking, chewing tobacco or gum, smoking and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in the exclusion zone or the contamination reduction zone. (Exceptions may be permitted by the PHSM to allow fluid intake during heat stress conditions.)
- 8. All lighters, matches, cigarettes and other forms of tobacco are prohibited in the Exclusion Zone.
- 9. All signs and demarcations shall be followed. Such signs and demarcation shall not be removed, except as authorized by the FOL/ESS.
- 10. No one shall enter a permit-required confined space without a permit. Confined space entry permits shall be implemented as issued.
- 11. All personnel must follow Hot Work Permits as issued.
- 12. All personnel must use the Buddy System in the Exclusion Zone.
- 13. All personnel must follow the work-rest regimens and other practices required by the heat stress program.
- 14. All personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.

HEALTH AND SAFETY WORK RULES CONTINUED

- 15. No person shall operate equipment unless trained and authorized.
- 16. No one may enter an excavation greater than four feet deep unless authorized by the Competent Person. Excavations must be sloped or shored properly. Safe means of access and egress from excavations must be maintained.
- 17. Ladders and scaffolds shall be solidly constructed, in good working condition, and inspected prior to use. No one may use defective ladders or scaffolds.
- 18. Fall protection or fall arrest systems must be in place when working at elevations greater than six feet for temporary working surfaces and four feet for fixed platforms.
- 19. Safety belts, harnesses and lanyards must be selected by the Supervisor. The user must inspect the equipment prior to use. No defective personal fall protection equipment shall be used. Personal fall protection that has been shock loaded must be discarded.
- 20. Hand and portable power tools must be inspected prior to use. Defective tools and equipment shall not be used.
- 21. Ground fault interrupters shall be used for cord and plug equipment used outdoors or in damp locations. Electrical cords shall be kept out walkways and puddles unless protected and rated for the service.
- 22. Improper use, mishandling, or tampering with health and safety equipment and samples is prohibited.
- 23. Horseplay of any kind is prohibited.
- 24. Possession or use of alcoholic beverages, controlled substances, or firearms on any site is forbidden.
- 25. All incidents, no matter how minor, must be reported immediately to the Supervisor.
- 26. All personnel shall be familiar with the Site Emergency Response Plan.

The above Health and Safety Rules are not all inclusive and it is your responsibility to comply with all regulations set forth by OSHA, the FWENC Environmental, Health and Safety Programs, the EHS plan(s), the client, FWENC Supervisors, and the FOL/ESS.



																																														8							١
ļ	Ć	١	Ċ	j	R	ī	2	Ċ	j	R	Á	Ľ	Ĭ	1	Š	3	E	Ś	ť	j	ī	ł	E	1	P	O	ij	Ż	1	Ħ	Ł									×		×				ŝ							١
ŀ			8												8								8			×						-	÷	÷	۰	٠	**	۰		۰	**	۰	۰	٠	۰	÷	۰	•	•	۰	٠		ŝ

FOSTER WHEELER ENVIRONMENTAL CORPORATION

		DENT/NE	IR MISS RE	<u>PORT A</u>	ND INVESTIC	GATION		<u></u>		
	<i>T</i>	YPE OF IN	CIDENT - C	HECK /	ALL THAT AP	PPLY			_	
☐ INJURY/ILLNESS ☐ SPILL/RELEASE			DAMAGE EXCEEDENC		PROPERTY I HIGH LOSS I (NEAR MISS	POTENTIA			FIRE OTHE	R
		(GENERAL IN	VFORM	*******************					
PROJECT/OFFICE:				REPOR'		DAT		REPORT		
DATE OF INCIDENT:					RY TIME: _			OF WE		
FW SUPERVISOR ON DUT				AT SCE	NE OF INCID	ENT: O	YES		NO	
LOCATION OF INCIDENT										
WEATHER CONDITIONS:			-		AT SCENE: - use addition		YES			'A
JANUARY)			20 10127 2					, <u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>		
	-						_	<u></u>		
							_			
							_			
						· · · · · · · · · · · · · · · · · · ·	***			
						·				
				·						
:										
		AFFEC	TED EMPLO	YEE IN	FORMATION					
NAME:										
HOME ADDRESS:					FWENC EN	<i>I</i> PLOYEE		O YE	S \square	NO
					FWENC EN	MPLOYEE	: 	O YE	S	NO
SOCIAL SECURITY #:					HOME PHO		<u>-</u>	O YE	<u>S</u>	NO
JOB CLASSIFICATION:						ONE #:				NO
	T PRIC	OR TO INCI	DENT:		НОМЕ РНО	ONE #: JOB CLAS	SIFIC			NO
JOB CLASSIFICATION:				LASSIF	HOME PHO YEARS IN YEARS WI	ONE #: JOB CLAS	SSIFIC	ATION:		NO
JOB CLASSIFICATION: HOURS WORKED ON SHIP		TINE TASK			HOME PHO YEARS IN YEARS WI ICATION:	ONE #: JOB CLAS TH FWEN	SSIFIC	ATION:		NO
JOB CLASSIFICATION: HOURS WORKED ON SHIP DID INCIDENT RELATE T	O ROU	TINE TASK	FOR JOB C		HOME PHO YEARS IN YEARS WI ICATION:	ONE #: JOB CLAS TH FWEN	SSIFIC	ATION:		NO
JOB CLASSIFICATION: HOURS WORKED ON SHIP	O ROU	TINE TASK	FOR JOB C		HOME PHO YEARS IN YEARS WI ICATION:	ONE #: JOB CLAS TH FWEN	SSIFIC	ATION:		NO
JOB CLASSIFICATION: HOURS WORKED ON SHIP DID INCIDENT RELATE T	O ROU	TINE TASK	FOR JOB C		HOME PHO YEARS IN YEARS WI ICATION:	ONE #: JOB CLAS TH FWEN	SSIFIC	ATION:		NO
JOB CLASSIFICATION: HOURS WORKED ON SHIP DID INCIDENT RELATE T	O ROU	TINE TASK INJU	FOR JOB C		HOME PHO YEARS IN YEARS WI ICATION:	ONE #: JOB CLAS TH FWEN	SSIFIC	ATION:		NO
JOB CLASSIFICATION: HOURS WORKED ON SHIP DID INCIDENT RELATE T NATURE OF INJURY OR II	O ROU	TINE TASK INJU S: CE CAUSIN	FOR JOB C IRYILLNES G HARM:		HOME PHO YEARS IN YEARS WI ICATION:	ONE #: JOB CLAS TH FWEN	SSIFIC	ATION:		NO
JOB CLASSIFICATION: HOURS WORKED ON SHIP DID INCIDENT RELATE T NATURE OF INJURY OR II OBJECT/EQUIPMENT/SUB	O ROU	TINE TASK INJU S: CE CAUSIN YES	FOR JOB C IRYILLNES G HARM:		HOME PHO YEARS IN YEARS WI ICATION:	ONE #: JOB CLAS TH FWEN	SSIFIC	ATION:		NO
JOB CLASSIFICATION: HOURS WORKED ON SHIP DID INCIDENT RELATE T NATURE OF INJURY OR II OBJECT/EQUIPMENT/SUB FIRST AID PROVIDED:	O ROU	TINE TASK INJU S: CE CAUSIN YES	G HARM:	is info	HOME PHO YEARS IN YEARS WI ICATION:	ONE #: JOB CLAS TH FWEN	SSIFIC	ATION:		NO

EAEHS PLAN FORMSUNCREP99.DOC • 7/22/99 1 300610

MEDICAL TRE	ATMENT INFORMAT	TON	
WAS MEDICAL TREATMENT PROVIDED?:	☐ YES	□ NO	•
IF YES, WAS MEDICAL TREATMENT PROVIDED:	☐ ON SITE	☐ DR.'S OFFICE	☐ HOSPITAL
NAME OF PERSON(S) PROVIDING TREATMENT:			
ADDRESS WHERE TREATMENT WAS PROVIDED:			
TYPE OF TREATMENT:			
VEHICLE AND PROP. VEHICLE/PROPERTY DAMAGED:	ERTY DAMAGE INFO	RMATION	
DESCRIPTION OF DAMAGE:			
SPILL AND AIR I	EMISSIONS INFORM	ITION	
SUBSTANCE SPILLED OR RELEASED:	FROM WHERE:	TO WI	HERE:
ESTIMATED QUANTITY/DURATION:			
CERCLA HAZARDOUS SUBSTANCE? YES ☐ NO	□ RQ EXCEEDE	D? YES 🗆 NO 🗆 S	PECIFY:
REPORTABLE TO AGENCY? YES □ NO □ SPE	ECIFY:		
WRITTEN REPORT? YES NO TIME FRA	ME:		
RESPONSE ACTION TAKEN	•		
PERMI	T EXCEEDENCE		
TYPE OF PERMIT:	PERMIT #:		
DATE OF EXCEEDENCE:	DATE FIRST KNO	OWLEDGE OF EXCE	EDENCE:
PERMITTED LEVEL OR CRITERIA (e.g., Water qualit	ty):		
EXCEEDENCE LEVEL OR CRITERIA:	EXCEEDENCE D	URATION:	
REPORTABLE TO AGENCY? YES □ NO □ SPE	ECIFY:		
WRITTEN REPORT? YES D NO D TIM	IE FRAME:	······································	
RESPONSE ACTION TAKEN:			
NO:	TIFICATIONS		
NAME(S) OF FWENC PERSONNEL NOTIFIED:		DATE/	ΓIME:
CLIENT NOTIFIED:	DATE/TIME:		
AGENCY NOTIFIED:	DATE/TIME:		OT REQUIRED
CONTACT NAME:			
PERSONS I	PREPARING REPORT		
EMPLOYEE'S NAME: (PRINT)	SIGN	•	
EMPLOYEE'S NAME (PRINT)	SIGN	•	
SUPERVISOR'S NAME: (PRINT)	SIGN	•	<u></u>
NOTE: Supervisor to forward a copy of Incident R	an ant to invest distance	mine DECM ECC	ESC I -41

NOTE: Supervisor to forward a copy of Incident Report to immediate supervisor, PESM, ESS or ESC, and other personnel as identified in Table 1 of this procedure ASAP, but no later then 24 hours.

2

REPORT	#-
TOTAL CITY	

INVESTIGATIVE REPORT

TE OF INCIDENT:			DATE OF	FINVESTIGATION	REPORT:	
INCIDENT COST:	ESTIMATED): \$	<u></u>	Α	CTUAL: \$	
OSHA RECORDABLE(S):	S):		# DAYS AW	DAYS AWAY FROM WORK		
			CAUSE ANALYSIS			
IMMEDIATE CAUSES – w	HAT ACTIONS	AND COND	ITIONS CONTRIBUTED TO THI	IS EVENT? (USE NEXT PA	AGE)	
BASIC CAUSES - WHAT SPE	CIFIC PERSONA	L OR JOB I	ACTORS CONTRIBUTED TO T	HIS EVENT? (USE NEXT F	'AGE)	
			ACTION PLAN			
REMEDIAL ACTIONS - W						MANAGEMENT
	PROGRAMS (S	EE ATTAC	HED LIST) FOR CONTROL OF IN	PERSON	TARGET	COMPLETION
	ACTION	I	•	RESPONSIBLE	DATE	DATE
	, <u>, , , , , , , , , , , , , , , , , , </u>					
					,	
	PEI	RSONS F	PERFORMING INVEST	IGATION		
INVESTIGATOR'S NAME:	(PRINT)		SIGN:			DATE:
INVESTIGATOR'S NAME:	(PRINT)		SIGN:			DATE:
INVESTIGATOR'S NAME:	(PRINT)		SIGN:			DATE:
		M.	INAGEMENT REVIEW	,		
PROJECT/OFFICE MANAG	ER (PRINT)		SIGN:			
COMMENTS:						
PESM or ESC (PRINT)			SIGN:			
COMMENTS:				· · · · · · · · · · · · · · · · · · ·		
	···					

EXAMPLES OF IMMEDIATE CAUSES

SUBSTANDARD ACTIONS

- 1. OPERATING EQUIPMENT WITHOUT AUTHORITY
- 2. FAILURE TO WARN
- 3. FAILURE TO SECURE
- 4. OPERATING AT IMPROPER SPEED
- 5. MAKING SAFETY DEVICES INOPERABLE
- 6. REMOVING SAFETY DEVICES
- 7. USING DEFECTIVE EQUIPMENT
- 8. FAILURE TO USE PPE PROPERLY
- 9. IMPROPER LOADING
- 10. IMPROPER PLACEMENT
- 11. IMPROPER LIFTING
- 12. IMPROPER POSITION FOR TASK
- 13. SERVICING EQUIPMENT IN OPERATION
- 14. UNDER INFLUENCE OF ALCOHOL/DRUGS
- 15. HORSEPLAY

SUBSTANDARD CONDITIONS

- GUARDS OR BARRIERS
- 2. PROTECTIVE EQUIPMENT
- 3. TOOLS, EQUIPMENT, OR MATERIALS
- 4. CONGESTION
- 5. WARNING SYSTEM
- 6. FIRE AND EXPLOSION HAZARDS
- 7. POOR HOUSEKEEPING
- 8. NOISE EXPOSURE
- 9. EXPOSURE TO HAZARDOUS MATERIALS
- 10. EXTREME TEMPERATURE EXPOSURE
- 11. ILLUMINATION
- 12. VENTILATION
- 13. VISIBILITY

EXAMPLES OF BASIC CAUSES

PERSONAL FACTORS

- CAPABILITY
- 2. KNOWLEDGE
- 3. SKILL
- 4. STRESS
- 5. MOTIVATION

JOB FACTORS

- 1. SUPERVISION
- 2. ENGINEERING
- 3. PURCHASING
- 4. MAINTENANCE
- 5. TOOLS/EQUIPMENT
- 6. WORK STANDARDS
- 7. WEAR AND TEAR
- 8. ABUSE OR MISUSE

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS

- 1. LEADERSHIP AND ADMINISTRATION
- 2. MANAGEMENT TRAINING
- 3. PLANNED INSPECTIONS
- 4. TASK ANALYSIS AND PROCEDURES
- 5. TASK OBSERVATION
- 6. EMERGENCY PREPAREDNESS
- 7. ORGANIZATIONAL RULES
- 8. ACCIDENT/INCIDENT ANALYSIS
- 9. PERSONAL PROTECTIVE EQUIPMENT

- 10. HEALTH CONTROL
- 11. PROGRAM AUDITS
- 12. ENGINEERING CONTROLS
- 13. PERSONAL COMMUNICATIONS
- 14. GROUP MEETINGS
- 15. GENERAL PROMOTION
- 16. HIRING AND PLACEMENT
- 17. PURCHASING CONTROLS

NOTIFICATION REMINDER

Fatalities or hospitalization (admittance) of three or more individuals requires notification to OSHA within 8 hours. Contact the Director, Health and Safety Programs or Director, ESQ Programs to make the notification. If unavailable, the senior operations person on site should make the notification.

INCIDENT/NEAR MISS REPORT AND INVESTIGATION INSTRUCTIONS

General: The incident report (pages 1 and 2) must be completed within 24 hours. Do not delay the report if any information is unknown. It can be provided later by revising the Report.

Type of Incident: Check all that apply. A High Loss Potential (Near Miss) incident is one that does not result in loss, but under slightly different circumstances, could have resulted in an OSHA Recordable injury, spill, release, permit exceedence, fire, or vehicle/property damage in excess of \$500. All High Loss Potential (Near Miss) incidents are to be investigated.

General Information

Project/Office: If the incident occurs on a delivery order contract, give the contract/program name, DO# and location. If the incident occurs on a C&E field project, give the Office location managing the project as well as the project/location.

Report No.: Optional numbering field for offices/projects.

FW Supervisor: The Foster Wheeler Supervisor responsible for the work effort involving the incident. Do not give a subcontractor supervisor or craft foreman name. If a Foster Wheeler Supervisor was the Affected Employee, this field should contain the name of his or her supervisor. The Supervisor is the project supervisor if the incident happens on a project, or the administrative supervisor if the incident happens in the office. E.g., a geologist, acting as an FOL gets injured on a job site, or in a motor vehicle in the course of project work. The FW Supervisor is most likely the Project Manager. If the same geologist gets injured lifting a box in his office, the FW Supervisor is likely the Office Science Lead.

Location of Incident: The specific location on the project, in the office, or off-site location.

Weather Conditions: Temperature, precipitation, approximate wind speed and direction, cloud cover, relative humidity. This information may be included in the description section, and must be given in detail whenever it is a factor in the cause or impact., e.g., spill, release, heat stress, wind blown material.

Describe What Happened: This section must be completed in sufficient detail to adequately describe the events and conditions leading up to and resulting from the incident. Try to answer the questions who, what, where, when, and how. This information is then used to determine why (cause). Provide details such as work objective, procedure being used, body position, and PPE. Include diagrams or sketches for all

incidents involving vehicles/equipment and other incidents where they aid in providing detail or perspective. Consider attaching photographs. Follow the guidelines in <u>Practical Loss Control Leadership</u>, and consider the impact of each of the following:

P - People

E - Equipment

M - Material

E – Environment

To do an effective job, a visual inspection of the scene is usually necessary along with private interviews of affected employees and witnesses.

Where appropriate, use terms indicating the type of contact, e.g., struck by; struck against; fall from elevation; fall on same level; caught in; caught between or under; caught on; contact with; overstress; equipment failure; environmental release; fire.

Affected Employee Information

FWENC Employee: Direct hire, whether professional, administrative, or craft; full-time or part-time; permanent or temporary. If the affected employee is not a FWENC employee, give the name of the employer and business relationship (e.g., client, subcontractor) in the description section above.

Hours Worked on Shift Prior to the Incident: Only include the amount of time the employee worked that shift or day prior to the incident.

Years with FWENC: For FWENC employees, give the number of years employed with FWENC. If the employee has worked for FWENC for less than a year, do not write <1. Give the answer in fraction of year, or specify the number of months, e.g., 0.1 or 1 month.

Injury/Illness Information

Nature of Injury or Illness: If the incident resulted in an injury or illness, give a brief description of the body part affected and type of injury or illness, e.g., fractured thumb, left hand; carpal tunnel syndrome, right hand.

First Aid Provided: First Aid is any treatment that does not have to be provided by a health care professional, even if it is. E.g., a laceration that is cleaned and bandaged in a clinic may constitute first aid, if sutures are not given.

Will the Injury Result In: Do not delay the report if this information is unknown.

Medical Treatment Information

Was Medical Treatment Provided? Medical treatment is that treatment that must be provided by a licensed medical practitioner, e.g., sutures, prescription medication, etc.

Type of Treatment: This information is important in determining OSHA recordability, since some forms of treatment would not constitute a Recordable case (e.g., one-time administration of prescriptions, negative diagnostic exams). Attach a copy of the treating professional's statement/work release.

Vehicle and Property Damage Information

Vehicle/Property Damaged: For vehicles, indicate VIN and whether it is company owned or leased, business trip rental (Avis) or owned by others.

Description of Damage: Be specific as to the identity of damaged part, location and extent.

Spill and Air Emissions Information

Substance Spilled or Released: For pure substances, list materials by common name/chemical. For wastes, indicate waste code. For mixtures or contaminated media, provide contaminant name, CAS No., concentration.

RQ Exceeded? Reportable quantity. Contact your ESQ representative for guidance. Specify the RQ for the material, whether you answer yes or no.

Reportable to Agency? If yes, specify the federal, state or local agency that must be provided with verbal and/or written notification

Written Report? Answer yes if the release requires a written report to be filed and note the time frame.

Response Action Taken: Describe the mitigation efforts, as well as any reports made, beyond initial notification.

Permit Exceedence

Type of Permit: List name of permit including the agency name where applicable (e.g., NPDES, PSAPCA NOC)

Date of Exceedence: Specify date exceedence occurred (e.g., date discharge in excess of permit limits occurred)

Date First Knowledge of Exceedence: Specify date when first knew there was an exceedence (i.e., date analytical received). This date may be different from the date of the exceedence listed above.

Permitted Level or Criteria: List numerical discharge or emission limit or narrative criteria specified in the permit (e.g., 20% opacity limit, Best Management Practices (BMP) implementation per SWPPP).

Exceedence Level or Criteria: Specify actual numerical discharge/emission limit or narrative criteria which was exceeded (e.g., 22% opacity, failure of BMPs (silt fencing collapse) per SWPPP)

Exceedence Duration: Specify time frame by date and hours (using military time) during which exceedence occurred.

See "Spill/Release Information" (above) for description of remaining questions.

Persons Preparing Report

Employee's Name: The affected employee described on page 1 should review the report and sign here, as well as other employees witnessing or involved in the incident.

Supervisor's Name: The FWENC Supervisor must review and sign the report indicating agreement. The FWENC Supervisor and the Investigator (next page) should be the same person.

Investigative Report

Report No.: This is the same as the project/office optional report number from page 1 of the Incident/Near Miss Report.

Date of Investigative Report: This date should be within 72 hours of the incident. In cases where the investigation is not completed until a later date, submit the incomplete report within the 72 hours, and a revised report should be submitted when the missing information is obtained.

Incident Cost: For all vehicle/equipment or property damage cases, an estimated or actual loss value must be entered. If an estimated value is entered, the report must be revised when the actual costs are known.

OSHA Recordables: This section should be completed in consultation with the PESM. If it cannot be determined at the time of the report, the PESM should consult with the Director, Health and Safety Programs and revise the report when a determination is made.

No. of Restricted Days: This relates to days of restricted work activity, not restrictions on motion or physical capability. If the employee is capable of doing his normal job the day after the injury and thereafter, there are no restricted days, even if the physician indicates a physical restriction. It does not include the day of the injury.

No. of Days Away from Work: The number of days after the day of the injury that the employee was scheduled to work but could not due to an occupational injury. If the treating physician releases an employee to return to work, but the employee chooses not to come to work, do not count those days. In this case the PESM should contact the Director, Health and Safety Programs.

Cause Analysis

Immediate Causes: Determine the immediate causes, using the example on page 4. If one or more of the examples fits the circumstance, use those words in the cause description. This facilitates statistical analysis of the incident database for program evaluation/modification. However, do not confine your cause determination to the guide words. Explain, e.g., Improper Lifting – employee attempted to lift box by bending at the waist and twisting while lifting. Be sure that the incident description on page 1 is sufficiently detailed to support the causal analysis in this section. An assumption of cause (e.g., improper lifting) from the injury (low back pain) is not acceptable.

Basic Causes: Like the Immediate Causes, use the guide words in the attachment whenever appropriate and explain. For example, improper motivation may be because the correct way takes more time or effort; short cutting standard procedure is tolerated or positively reinforced; or the person thinks there is no personal benefit to always doing the job correctly.

<u>Note</u>: The investigator is encouraged to review the <u>Practical Loss Control Leadership</u> chapters on *Causes and Effects of Loss* and *Accident/Incident Investigation* before doing the causal analysis. As a check, the investigator may refer to the S.C.A.T. Chart available from the PESM.

Remedial Actions: Include all actions taken or those that should be taken to prevent recurrence. Be sure that actions address the causes. For example, training (safety meetings) may be a necessary response for lack of knowledge, but may be inadequate for improper motivation. If completion dates exceed the 72 hours reporting period, a revised report must be submitted when all remedial actions are complete.

Persons Performing Investigation: The primary investigator is the FWENC Supervisor in charge of the work where the incident occurred. Others participating in the investigation, such as the Project Manager, ESS, QC, site engineer, foreman, etc. should also sign the report.

Management Review: The Project or Office Manager and the PESM or office ESC must sign the report indicating their satisfaction with thoroughness of the investigation and the report, and their concurrence that the action items address the identified causes. This constitutes the peer review, and the

report, particularly the description, should be clear to readers not familiar with the project or incident.

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Provisions of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a compliant with their nearest OSHA office within 30 days of the alleged discriminatory action.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory civil penalties against employers of up to \$7,000 for each serious violation and for optional penalties of up to \$7,000 for each nonserious violation. Penalties of up to \$7,000 per day may be proposed for failure to correct violations within the proposed time period and for each day the violation continues beyond the prescribed abatement date. Also, any employer who wilffully or repeatedly violates the Act may be assessed penalties of up to \$70,000 for each such violation. A minimum penalty of \$5,000 may be imposed for each wilfful violation. A violation of posting requirements can bring a penalty of up to \$7,000.

There are also provisions for criminal penalties. Any willful violation resulting in the death of any employee, upon conviction, is punishable by a fine of up to \$250,000 (or \$500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment. Falsifying records, reports, or applications is punishable by a fine of \$10,000 or up to six months in jall or both.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State Labor or Health department or a State university.

Posting Instructions

Employers in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations: Atlanta, GA (404) 347-3573 Boston, MA (617) 565-7164 Chicago, IL (312) 353-2220 Dallas, TX (214) 767-4731 Denver, CO (303) 391-5858 Kansas City, MO (816) 426-5861 New York, NY (212) 337-2378 Philadelphia, PA (215) 596-1201 San Francisco, CA (415) 744-6670 Seattle, WA (206) 553-5930

Rom BRish

Washington, DC 1996 (Reprinted) OSHA 2203

Robert B. Reich, Secretary of Labor

U.S. Department of Labor

Occupational Safety and Health Administration
Washington, DC 1995 (Reprinted) OSHA 2203

This information will be made available to sensory impaired individuals upon request. Voice phone: (202) 219-8615; TDD message reterral phone: 1-800-326-2577

GPO: 1995 0 - 183-097 QL 3



300617

ATTACHMENT 2



FOSTER WHEELER ENVIRONMENTAL CORPORATION DAILY BRIEFING SIGN-IN SHEET

Date: Project Name/Location:			
Shift/Department: Person Conducting Briefing:			
1. AWARENESS (e.g., special EHS concerns, pollution prevention, recent incidents, etc.):			
2. OTHER ISSUES (EHS Plan	changes, attendee comments, etc.):		
3. ATTENDEES (Print Name)			
1.	21.		
2.	22.		
3.	23.		
4.	24.		
5.	25.		
6.	26.		
7.	27.		
8.	28.		
9.	29.		
10.	30.		
11.	31.		
12.	32.		
13.	33.		
	34.		
15.	35.		
16.	36.		
17.	37.		
18.	38.		
19.	39.		
20.	40.		

ATTACHMENT 2 Page 1 of 1



FOSTER WHEELER ENVIRONMENTAL CORPORATION

	DA	ILY EQUIPMENT	INSPECTIO	V	
EQUIP. NO)		TYPE		
MANUFACTURER					
PROJECT					
	RS/MILEAGE				
	Check appropria				
	•• •	Condition Go		Correction Needed	
;	Steering _				
;	Service Brakes		· ·		
i	Emergency Brakes				
l	Retarder _	•			
	Transmission _				
	Controls				
	Hydraulic Leaks				
	Exhaust System _		<u> </u>		
	Warning Gauges _		<u> </u>	-	
	Windshield				
	Lights				
	Mirrors				
	Seat and Seat Belts				
	Tires/Tread				
	Regular Horn				
	Back-up Alarm				
	Steps, Hand-holds				
	Fire Extinguisher			.	
	Rollover Cage Other				
	other _				
Remarks:					
			······		
	7				
		Signed			
		-	Operator	/ 	_ -
-	adjustments completed:		•		
Date:		Signed Equipment Sup-			
		Equipment Sup	ervisor/ivieci	anic	

APPENDIX F

TEMPERATURE EXTREMES PROGRAM, DRILL RIG SAFETY PROGRAM, EXCAVATION AND TRENCHING PROGRAM

EHS 4-6:

Temperature Extremes (Previously HS4-6)

The purpose of this program is to prevent heat and cold stress related injuries and illnesses at field operations.

Version Date: 03/17/98 - Revised 02/01/95 Original Issue

Date:

Department/Category: Environmental, Health &

Safety - Programs

Document Type: Procedure

Keyword Index: EHS Compliance/Waste Management, Monitoring, Operational Control, Training

Approved by:

FOSTER WHEELER ENVIRONMENTAL CORPORATION

NOTICE OF OWNERSHIP AND CONDITIONS OF USE

This document is the property of Foster Wheeler Environmental Corporation (FWENC) and is loaned for use subject to recall for any reason at any time without prior notice and with the distinct understanding that it is to be used only for the duration of and in connection with the performance of work for FWENC. Please observe that the material herein is copyrighted and protected by the laws pertaining to copyright.

Should any circumstances arise under which you will no longer require this document for the specific purpose for which it is loaned to you, it must be returned promptly. Under no circumstance shall this document be transferred or loaned to any other individual, firm, or corporation without the express written permission of the CEO or designee.

In the event such permission is obtained, the person who obtains such permission shall be responsible for obtaining compliance with the conditions set forth in this Notice by any person to whom he/she may loan this document.

This document will be updated periodically as new concepts and practices are developed. Such revisions shall be effected by issuing new or revised sections to ensure uniform practices. Deviations to the enclosed information may be authorized, when appropriate, based upon warranted circumstances.

Sections shall not be removed from this document except as required by revisions or cancellations. Employees are not to rely on printed versions of this document and shall refer to the Lotus Notes database for the most current requirements.

> Copyright 6 1995, 1998 Foster Wheeler Environmental Corporation **Proprietary Information**

Table of Contents

Section

- 1.0 PURPOSE
- 2.0 SCOPE
- 3.0 MAINTENANCE
- 4.0 DEFINITIONS
 - 4.1 Adjusted Temperature
 - 4.2 Deep Frostbite
 - 4.3 Frostbite
 - 4.4 Frostnip or Incipient Frostbite
 - 4.5 Heat Cramp
 - 4.6 Heat Exhaustion
 - 4.7 Heat Rash
 - 4.8 Heat Stroke
 - 4.9 Hyperthermia
 - 4.10 Hypothermia
 - 4.11 Superficial Frostbite
 - 4.12 Wet-Bulb Globe Temperature (WBGT)
 - 4.13 Wind-Chill Factor or Equivalent Chill Temperature (ECT)
 - 4.14 Work/Rest Regimen

5.0 DISCUSSION

- 5.1 Responsibilities
 - 5.1.1 Field Personnel
 - 5.1.2 Line Management
 - 5.1.3 Environmental, Health and Safety Personnel
- 5.2 General Program Requirements
- 5.3 Heat Stress
 - 5.3.1 Selection of Chemical Protective Clothing
 - 5.3.2 Hydration
 - 5.3.3 Cool Rest Areas
 - 5.3.4 Other Prevention Program Elements
 - 5.3.5 Training
- 5.4 Cold Stress
 - 5.4.1 Personal Protective Equipment
 - 5.4.2 Engineering Controls
 - 5.4.3 Warm Rest Areas
 - 5.4.4 Work/Warm-up Schedule
 - 5.4.5 Training
- 6.0 REFERENCES
- 7.0 ATTACHMENTS

1.0 PURPOSE

The purpose of this program is to prevent heat and cold stress related injuries and illnesses at field operations.

2.0 SCOPE

This program applies to all Foster Wheeler Environmental Corporation (FWENC) and subcontractor field personnel that may be exposed to heat or cold stress during the performance of their field work assignments.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with FWENC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Director, Administration and Compliance.

4.0 DEFINITIONS

4.1 Adjusted Temperature

The dry bulb temperature adjusted to account for solar radiation, to be used as a heat stress indicator for personnel in impermeable protective clothing.

4.2 Deep Frostbite

The tissue beneath the skin is solid to the touch; it may involve a full thickness freeze to the bone. This is an extreme emergency and can result in permanent tissue loss.

4.3 Frostbite

Freezing of body tissue.

4.4 Frostnip or Incipient Frostbite

A cold related injury that progresses slowly and is painless while developing. The victim is usually unaware that he/she has frost nip. The skin first becomes reddened, then changes to white; no freezing of tissue occurs.

4.5 Heat Cramp

Painful muscle spasms usually occurring on the arms, legs, and abdomen; caused by excessive loss of body electrolytes from profuse sweating.

4.6 Heat Exhaustion

A form of shock that occurs when the body loses large amounts of water and electrolytes from excessive perspiration after exposure to heat and physical activity; also called heat prostration.

4.7 Heat Rash

Profuse tiny raised red vesicles (blister-like) on affected areas of the skin which cause a prickling sensation during heat exposure.

4.8 Heat Stroke

A <u>life-threatening</u> condition caused by rapidly rising body core temperature that occurs when the body's temperature regulating mechanisms are overwhelmed. Sweating stops and the skin is dry and hot.

4.9 Hyperthermia

A rise in body core temperature above 99.6 C.

4.10 Hypothermia

Decreased body core temperature from prolonged exposure to freezing or near-freezing temperatures. This is the most life-threatening cold injury and affects the entire body with possible localized severe cooling.

4.11 Superficial Frostbite

Frostbite which affects the skin and tissue just beneath the skin. The skin is firm and waxy, tissue beneath is soft and numb. The skin turns purple and may tingle and burn during warming.

4.12 Wet-Bulb Globe Temperature (WBGT)

Method used to measure the environmental factors (e.g., temperature, relative humidity) which impacts the body's physiological responses to heat.

4.13 Wind-Chill Factor or Equivalent Chill Temperature (ECT)

An index describing the effect of the cooling power of moving air on exposed flesh. The effect of wind velocity at a certain temperature is expressed as the equivalent cooling effect of a lower temperature with still air.

4.14 Work/Rest Regimen

The ratio of time spent working to time spent resting in an area designed to relieve heat related conditions. This ratio is expressed in one hour periods. Example: A work/rest regimen of 75% work, 25% rest corresponds to 45 minutes work, 15 minutes rest each hour.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Field Personnel

All field personnel will be trained in heat and cold stress prevention and treatment. Field personnel will monitor themselves and their workmates for symptoms of heat and cold stress and will inform the Environmental and Safety Supervisor (ESS) or their supervisor immediately should symptoms become apparent.

5.1.2 Line Management

Site Supervisors have the responsibility to:

- Provide resources and facilities necessary to prevent health effects from temperature extremes
- Enforce work rules related to such prevention
- Ensure implementation of the requirements of this program as specified in the Site Environmental, Safety and Health (EHS) plans.

5.1.3 Environmental, Health and Safety Personnel

The Project Environmental and Safety Manager (PESM) will make the initial determination of heat and cold stress prevention requirements as part of the site EHS Plan (see EHS 3-2, EHS Plans) and oversee the implementation of this program on a project basis for all FWENC field programs.

The ESS will assist with implementation of heat and cold stress prevention programs. The ESS will, in most cases, be the person responsible for monitoring heat and cold stress on the job,

determining work/rest and work/warm-up schedules where used, and will implement emergency response or corrective action, if needed. The ESS will train site personnel on the effects of temperature extremes and the site prevention program, and will maintain records related to this program.

5.2 General Program Requirements

Adverse weather conditions must be considered when planning site operations. Excessively hot or cold working environments can produce a number of different injuries. Critical to the ability to care for those injuries is a basic understanding of the way in which the body maintains its temperature and how it physiologically adjusts to extremes of heat and cold. Attachment A provides information on the body's physiological responses to heat and cold stress.

Proper care of victims who are suffering from the effects of heat or cold exposure will help to minimize injuries and speed recovery. On the other hand, improper treatment of these emergencies can result in serious injury, disability, or death.

The most effective first aid for any injury is prevention. When acceptable monitoring and prevention programs are followed, there should be no victims.

5.3 Heat Stress

A heat stress prevention program will be implemented when ambient temperatures exceed 70°F for personnel wearing impermeable clothing and for other personnel when the WBGT index exceeds the ACGIH Threshold Limit Values.

5.3.1 Selection of Chemical Protective Clothing

The PESM will review site data and working conditions and select the personal protective equipment ensemble that best protects the employees from site hazards. The risk of heat related illness will be fully considered in balancing the risks and benefits of the PPE. Where contact with a waste material is unlikely; contact is not expected to result in a serious dermal hazard; and significant absorption of the contaminants is not likely to occur, then impermeable clothing should not be required. In this case, the risk of heat related illness may grossly outweigh the benefits provided by such equipment. Even when chemical protective clothing is needed, the PESM should consider the probable exposure scenarios and select protective equipment accordingly. For example, if dermal exposure is likely to be localized, strong consideration should be given to using gloves, boots, gauntlets, leggings, aprons, bibs, face shields, etc., in lieu of full body coveralls and respirators.

5.3.2 Hydration

FWENC will supply cool (50-59 F) potable water or other suitable drinks (e.g., sport electrolyte replacements) for fluid replacement. Employees involved in the heat stress prevention program will be trained and encouraged to drink at a rate of approximately 8 oz. every 20 minutes. Individual cups will be used and kept in closed containers or dispensers.

5.3.3 Cool Rest Areas

Shaded rest areas will be provided. On large remediation projects, air conditioned rest areas should be provided for workers exposed to heat stress conditions.

5.3.4 Other Prevention Program Elements

The PESM, ESS and the Project Manager will incorporate other elements into the heat stress prevention program as necessary. The selected elements will be described in the EHS plans. Engineering controls are preferred. Where their use is not feasible, the program must incorporate administrative/work practice controls, personal protective equipment, or a combination. Examples of other prevention program elements include:

• Engineering Controls

Engineering controls may include:

- Air conditioned cabs for heavy equipment and vehicles (Such controls may eliminate the need for other program elements);
- Fans or blowers; and
- Cold water for drenching personnel in impermeable clothing. This can be provided through a garden hose, a garden sprayer filled with ice water, a clean drum full of water for "hard hat dipping" or containers of ice water and clean towels in the rest area to hasten cool down.

Administrative and Work Practice Controls

Administrative controls include:

- Adjusting work schedules to do the bulk of the work during the cooler parts of the day;
- Acclimatizing workers; and
- Implementing work/rest regimens (See Attachment B for Work/Rest Regimen Procedures).

Personal Protective Equipment

Personal cooling devices which may be useful include:

- Ice vests;
- Circulating water vests; and
- Vortex tubes.

Where ice vests and circulating water vests are used, rest periods of approximately 15 minutes should be taken when ice packs or batteries need to be changed. Continuous work over long periods of time with these devices may present an increased musculoskeletal injury risk due to the extra weight. Since the duration of the cooling effectiveness of these devices will vary with heat and work loads, users must be instructed to leave the area to replenish ice or batteries at

the first sign of loss of cooling.

Monitoring

A program of environmental and physiological monitoring must be established in order to use work/rest regimens. The monitoring procedures are described in Attachment B.

5.3.5 Training

All site personnel must receive training on the following topics:

- Health effects of hot environments and symptoms of heat related illness;
- Personal risk factors:
- Effect of personal protective equipment on heat stress conditions;
- Preventive measures;
- Fluid replacement;
- Elements of the site Heat Stress Prevention Program; and
- · First aid and emergency response.

Records shall be maintained in accordance with EHS 1-9, Recordkeeping.

5.4 Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trenchfoot or immersion foot, and hypothermia as well as slippery surfaces, brittle equipment, poor judgement and taking short cuts. The current ACGIH threshold limit values (TLVs) for cold stress will be used as a guideline. FWENC will implement the following cold stress prevention program elements when there is a potential for cold related injuries.

5.4.1 Personal Protective Equipment

The following personal protective equipment will be provided as necessary to FWENC employees when conditions indicate a potential for cold-related injury. Subcontractors will be expected to supply appropriate equipment to their employees.

- Hard hat liners,
- Gloves or glove liners,
- Rain gear or water impermeable coveralls and gloves for potentially wet operations,
- Fleeced boot liners where rubber steel-toe boots are used, and
- Winter coveralls.

5.4.2 Engineering Controls

A variety of engineering controls shall be evaluated to minimize cold stress. These include:

- General or spot heating should be used to increase temperature at the workplace.
- If fine work is to be performed with bare hands in a cold environment, special provisions should be made to keep the worker's hands warm. Warm air jets, radiant heaters, or contact warm plates can be used.
- The work area should be shielded from winds and drafts that may affect the wind chill factor.
- The air velocity in refrigerated rooms should be minimized as much as possible, and should not exceed 1m/sec in the work zone.
- At temperatures below freezing, metal handles of tools and control bars should be covered with thermal insulating material.
- Unprotected metal chair sets should not be used as they conduct heat away from the body.
- When necessary, equipment and processes should be substituted, isolated, relocated, or redesigned to reduce cold stress at the worksite.
- Power tools, hoists, cranes, or lifting aids should be used to reduce metabolic workload.
- Heated warming shelters such as tents and cabins should be made available if work is performed continuously in an equivalent chill temperature of 20°F or below.
- The ESS may implement a work-rest schedule to reduce exposure to cold stress.
- Scheduled rest breaks should be enforced.
- Personnel exposed to the cold should be provided the opportunity for frequent intake of warm, sweet, caffeine-free, nonalcoholic liquids or soup.
- Work should be moved to warmer areas whenever possible.
- Extra workers should be assigned to highly demanding tasks.
- Workers should be allowed to pace themselves, taking breaks when needed.
- Workers shall be trained in the prevention, symptoms, and emergency response to cold stress.
- Utilize the "buddy system" to monitor cold stress symptoms among the workers.
- Allow new employees time to adjust or "acclimate" to cold conditions.
- Minimize the need to sit or stand in one place for long periods of time.
- Minimize the amount of work time spent in a cold environment.
- Allow for the weight and bulkiness of protective clothing when estimating work performance

goals and tasks.

5.4.3 Warm Rest Areas

FWENC will make warm rest areas, e.g., heated trailers, available for rest breaks in cold weather. Employees will be permitted and encouraged to use the heated trailers whenever they experience symptoms of cold stress.

5.4.4 Work/Warm-up Schedule

The work/warm-up schedule found in the ACGIH TLVs for cold stress will be followed. In addition, FWENC will make warm-up periods available to employees who need to change into dry clothing to prevent immersion foot or hypothermia.

5.4.5 Training

All FWENC employees and subcontractors will be trained in:

- The effects of cold stress, including frostbite, immersion foot and hypothermia;
- Personal risk factors;
- · Recognition of the symptoms;
- · Methods employees can use to protect themselves; and
- First aid procedures and recognition of medical emergencies.

Records shall be maintained in accordance with EHS 1-9, Recordkeeping.

6.0 REFERENCES

ACGIH (American Conference of Government Industrial Hygienists)

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, 1994-95.

Environmental Health & Safety Programs EHS 1-9, Recordkeeping

Environmental Health & Safety Programs EHS 3-2, EHS Plans

NIOSH (National Institute for Occupational Safety and Health)

Occupational Exposure to Hot Environments, Revised Criteria 1986.

NIOSH/OSHA/EPA/USCG/EPA

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October 1985.

National Safety Council

Fundamentals of Industrial Hygiene. Third Edition, 1988.

7.0 ATTACHMENTS

Attachment A - Heat and Cold Stress Information Attachment B - Work/Rest Regimens and Monitoring

ATTACHMENT A (Page 1 of 6) HEAT AND COLD STRESS INFORMATION



FOSTER WHEELER ENVIRONMENTAL CORPORATION HEAT AND COLD STRESS INFORMATION

HEAT STRESS

Hot weather can cause physical discomfort, loss of efficiency, and personal injury. The human body strives to maintain a constant core temperature of 98.60. If this temperature is to be maintained, heat loss must equal heat production. This balance is maintained by variations in the blood flow to the outer part of the body. When the core temperature rises, blood vessels beneath the skin dilate, and the blood brings increased heat to the skin, where it is dissipated by radiation and convection. This works only as long as the skin temperature is lower than the temperature of the outside environment. Heat loss by radiation convection is impossible when the temperature of the outside air approaches or exceeds the temperature of the skin. The body will now rely on dissipation through evaporation of sweat. But the sweat mechanism also has limits. The normal adult can sweat only about one liter per hour and can sweat at that rate for only a few hours at a time. In addition, sweating only works if the relative air humidity is low. Sweat evaporation ceases entirely when the relative humidity reaches 75 percent.

Of particular concern in heat stress monitoring is the use of personal protective clothing which decreases natural body ventilation and greatly increases the temperature and humidity to the skin. If precautions are not taken, heat stress will progress into a heat-related injury. Heat-related injuries fall into three major categories: heat cramps, heat exhaustion, and heat stroke.

Heat Cramps

Symptoms

Heat cramps are the least common and least severe of heat injuries. Heat cramps occur when the electrolytic balance in the blood between water, calcium, and sodium (salt) is altered. Low blood salt level, from profuse sweating and inadequate salt consumption, is the usual cause.

Symptoms of heat cramps include:

- Severe muscle cramps and pain, especially of the upper legs, calves, and abdomen, and occasionally in the arms
- Faintness and dizziness
- Possible nausea and vomiting

Treatment

Emergency care will include:

Remove victim from the hot environment

ATTACHMENT A (Page 2 of 6)

HEAT AND COLD STRESS INFORMATION

- Dilute one teaspoon of salt in one quart of water or use a commercial product with a low glucose content; allow victim to sip this solution at the rate of one-half glassful every 15 minutes
- To relieve pain, gently stretch the involved muscle group; gently message cramps as long as it does not increase the pain or discomfort

The victim should avoid exertion of any kind for 12 hours. A victim of heat cramps is prone to recurrence.

Heat Exhaustion

Symptoms

Heat exhaustion is the most common heat injury and usually occurs in an individual who is involved with heavy physical exertion in a hot, humid environment, and is wearing protective clothing. Heat exhaustion is a mild state of physical shock caused by the pooling of blood in the vessels just below the skin, causing blood to flow away from the major organs of the body. Due to prolonged and profuse sweating, the body also loses large amounts of salt and water.

The symptoms of heat exhaustion include:

- Profuse sweating
- Pale, cool, sweaty skin
- Headache and extreme weakness, fatique
- Nausea and possible vomiting
- Dizziness and faintness
- Collapse and possible brief unconsciousness
- Body core temperature normal, may even be slightly below normal

Treatment

Emergency care will include:

- Remove victim from the hot environment and out of the exclusion zone
- Lie victim down with feet slightly raised
- Remove as much clothing as reasonable (especially personal protective clothing); loosen what cannot be removed
- Apply cold, wet compresses to the skin; fanning will also aid in cooling
- If the victim is fully alert, allow him/her to drink water or the same solution, at the same rate, that was used for the emergency care of heat cramps
- If the victim vomits, do not give fluids by mouth, transport him/her to a hospital immediately (dehydration is the most critical problem in heat exhaustion victim; intravenous fluids will have to be given)
- Take oral temperature every 10 minutes, if the victim's temperature is above 101 or shows a steady increase, transport to a hospital immediately and start sponging him/her off with cool water

ATTACHMENT A (Page 3 of 6) HEAT AND COLD STRESS INFORMATION

Heat Stroke

Heat stroke is a true life-threatening emergency having a mortality rate of 20 to 70 percent. This condition results when the heat regulating mechanisms of the body break down and fail to cool the body sufficiently. The body temperature rises to between 105 and 110 F; no sweating occurs in about 50 percent of the victims. Because no cooling takes place, the body stores increasingly more heat, and eventually brain cells are damaged, causing permanent disability or death. About 4,000 Americans die of heat stroke annually.

There are two basic kinds of heat stroke: classic heat stroke and exertional heat stroke. Classic heat stroke, in which people lose the ability to sweat, generally effects the elderly or chronically ill. Exertional heat stroke, in which victims retain the ability to sweat, is accompanied by physical exertion and muscle stress. Exertional heat stroke is the type that will be most commonly encountered on a field operation requiring strenuous physical activity.

The symptoms of heat stroke include:

- Oral temperature of 105 F or higher
- Hot, reddish skin, skin is usually dry
- Headache
- Dry mouth
- Shortness of breath
- Nausea or vomiting
- Increasing dizziness and weakness
- Mental confusion and anxiety; victims may show unusual irritability, aggression, combative agitation, or hysterical behavior
- Convulsions, sudden collapse and possible unconsciousness; all heat stroke victims having varying levels of consciousness, ranging from disorientation to coma

Treatment

Emergency care will include:

- Remove the victim from the hot environment and from the exclusion zone
- Call for trained emergency medical personnel immediately
- Remove as much clothing as reasonable (especially personal protective clothing); cut clothing with bandage scissors, if necessary, being careful not to injure victim
- Pour cool water over the victim, avoiding his nose and mouth
- Fan the victim
- Place cold packs under the arms and against neck and ankles
- Wrap victim in a wet blanket
- Continue a combination of these methods until the oral temperature falls below 103 F (take
 measures to prevent chilling, if necessary, i.e., use slower cooling if the victim starts
 shivering
- Elevate the head and shoulders slightly during cooling
- Never give the victim anything to drink unless fully conscious and vomiting is unlikely
- Because heat stroke involves the entire body, a number of complications may result:
- Brain swelling, convulsions, coma, kidney failure, liver failure, high blood pressure and heart failure.

Therefore, always transport the victim to a hospital even if the body core temperature has lowered to near normal.

ATTACHMENT A (Page 4 of 6) HEAT AND COLD STRESS INFORMATION

The two most reliable and distinct differences between heat stroke and heat exhaustion are:

Heat Stroke

- Skin flushed (red); may be dry; hot to touch
- Oral temperature above 105°F.

Heat Exhaustion

- Skin pale; wet or clammy; cool to touch
- Oral temperature usually normal.

Cold Stress

Hypothermia is a drop in the core body temperature below 98.6 F. The first symptoms of hypothermia are uncontrollable shivering and the sensation of cold; this is followed by a slowed and sometimes irregular heart beat, a weakened pulse and a drop in blood pressure. Vague or slow slurred speech, memory lapses, apathy, incoherence and drowsiness can occur. Other symptoms may include cool skin, slow, irregular breathing, apparent exhaustion, and fatigue after rest.

Prevention

Hypothermia is caused by prolonged exposure to a cold environment, whether air, water, or snow and ice. Adequate dry clothing with appropriate insulating capacity must be provided to workers to prevent hypothermia, especially if work is performed in air temperatures below 40 F. Wind chill is a critical factor. Work at a slow but steady pace. The job should be a "no sweat" operation.

Unless there are unusual or extenuating circumstances, cold injury to other than the extremities (hands, feet, and head) is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against hypothermia. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered for these workers. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Treatment

First aid for mild hypothermia will be performed as follows:

- 1. End the exposure get the victim out of the cold and wet.
- 2. Replace wet clothing with dry or add insulation to clothing.
- 3. Offer warm, non-alcoholic fluids.
- 4. Increase exercise.
- 5. Seek shelter from wind, wet and cold.

ATTACHMENT A (Page 5 of 6) HEAT AND COLD STRESS INFORMATION

<u>CAUTION</u>: If the victim remains cold for a number of hours, chemical changes may have taken place which, on rewarming, may cause major medical problems for the victim and which could result in death. <u>Severely hypothermic victims are best warmed in the hospital under controlled <u>conditions</u>. If a severely hypothermic victim cannot be transported to a hospital within a few hours, rewarming should begin in the field.</u>

Symptoms

Frostbite can occur either before or after the onset of hypothermia when body tissue (usually an extremity) is exposed to freezing temperatures. Frostbite occurs when the fluids surrounding tissue cells freezes. The danger of frostbite increases with increased wind chill and/or reduced temperatures below 32 F. Frostbite can also occur if tissues are in prolonged contact with a frozen material or object. Skin contact with frozen metal, for example, can result in frostbite in a short period of time, even in a warm environment.

There are three degrees of frostbite:

- First degree freezing without blistering or peeling, "frostnip"
- · Second degree freezing with blistering and/or peeling, and
- Third degree freezing resulting in the death of skin tissue and possibly the death of underlying tissues as well

Symptoms of frostbite include the following:

- The skin changes color to white or grayish-yellow, progresses to reddish-violet, and finally turns black as the tissue dies
- Pain may be felt at first, but subsides
- Blisters may appear, and
- The affected area is cold and numb

Prevention

Frostbite can be prevented by wearing sufficient protection to prevent skin from coming into prolonged contact with a freezing environment. The following steps can be taken:

- 1. Wear sufficient clothing. Mittens are better than gloves. Face masks and wool stocking caps are better than hats. Wind and waterproof hoods protect the face and neck.
- 2. Clothing should be loose enough to prevent constriction of blood vessels. Boots must be roomy enough to permit movement of the toes with no feeling of tightness.
- 3. Do not contact conductive metals or contact gasoline or other solvents with bare skin as rapid evaporation of solvents may quickly lead to frozen tissues in a cold environment.
- 4. Exercise the toes and fingers to maintain circulation.
- 5. Observe the condition of your partners' face, hands and ears frequently for signs of frostbite.
- 6. Avoid smoking and drinking alcoholic beverages.

ATTACHMENT A (Page 6 of 6) HEAT AND COLD STRESS INFORMATION

Treatment

First aid for superficial (first degree) frostbite is as follows:

- Place a warm body part next to the frozen area, applying firm, steady pressure.
- 2. DO NOT RUB THE AREA. Rubbing may cause further damage to already injured skin.
- 3. Protect the area from further freezing.

First aid for <u>deep frostbite</u> (<u>second and third degree</u>) is as follows:

- 1. KEEP THE FROZEN PART FROZEN!
- 2. Prevent further injury: avoid rubbing and further freezing of unaffected tissue.
- 3. If the part has thawed, the part should NOT be allowed to refreeze or bear weight. A victim with thawed feet should be carried out.
- 4. Give the victim plenty of fluids and evacuate to medical assistance as soon as possible.

Symptoms

This condition may be caused by long, continuous exposure to cold without freezing, combined with persistent dampness or actual immersion in water. Edema (swelling), tingling, itching, and severe pain occur, and may be followed by blistering, death of skin tissue, and ulceration. When other areas of the body are affected besides the feet, the condition is known as chilblains.

Prevention

Trenchfoot and chilblains can be prevented by keeping the body as dry as possible at all times. Waterproof boots should be worn when required, but provisions must be made for preventing excessive perspiration to accumulate inside the boots. Socks should be changed at least twice daily and the boots wiped dry inside with each change of socks. The feet should also be wiped dry and foot powder applied.

Treatment

Affected body parts should not be rubbed or massaged, but bathed in water using plain white soap. Dry thoroughly and elevate the body part, allowing the body part to be exposed at room temperatures. If the feet are affected, do not walk during treatment.

ATTACHMENT B (Page 1 of 5)

WORK/REST REGIMENS AND MONITORING



FOSTER WHEELER ENVIRONMENTAL CORPORATION

HEAT STRESS WORK/REST REGIMES AND MONITORING

Introduction

Establishing a work/rest regimen that allows work to be completed in a timely manner while providing adequate rest time to prevent heat stress requires involvement of the ESS, FOL, and individuals involved. In many cases, particularly when wearing normal field type clothing (i.e., level D), awareness and communication are the key elements to a successful program. Allowing rest periods on an "as needed" basis while ensuring vigilance for initial symptoms of heat stress, encourages this success.

There are times when this approach is not appropriate. When heat stress contributing protective clothing (e.g., respirators, impermeable coveralls) are worn for extended periods, or when "as needed" work/rest regimens adversely impact either the individuals exposed to the heat source or work completion, a more formal work/rest regimen will be established.

Formal work/rest regimens are based either on 1) monitoring ambient conditions (e.g., with a WBGT), estimating work loads and establishing work/rest times, 2) monitoring physiological conditions and adjusting work/rest periods, or 3) using personnel heat stress monitors.

The WBGT, physiological monitors, and personnel heat stress monitors will be used in accordance with manufacturer's instructions. Personnel heat stress monitors will be approved for use by the PESM.

II. WBGT Based Work/Rest Regimens

A. Work/Rest Regimens

When required, the WBGT will be used in conjunction with the work load to determine the appropriate work/rest regimen for personnel wearing regular work clothing or semipermeable disposal coveralls (uncoated Tyvek). Light work examples include sitting or standing or performing light hand or arm work. Moderate work includes walking about with moderate lifting and pushing. Heavy work corresponds to pick and shovel-type work.

The work/rest regimen using the WBGT procedure will be used as a guideline. Table B-1 outlines the work/rest regimen guidelines based upon WBGT temperature and work load. Table B-2 identifies the correction factors. The WBGT temperature will be determined in accordance with Section B of this attachment.

ATTACHMENT B (Page 2 of 5)

WORK/REST REGIMENS AND MONITORING

Table B-1. Examples of Permissible Heat Exposure Threshold Limit Values. (Values are given in °F WGBT)*

		Work Load	
Work - Rest Regimen	Light	Moderate	Heavy
Continuous work	86	80	77
75% Work -	87	82	78
25% Rest, each hour 50% Work -	89	85	82
50% Rest, each hour 25% Work -	90	88	86
75% Rest, each hour			

^{*} Notes on Table B-1

- 1) These values are for fully acclimatized workers wearing light weight pants and shirts. For conditions other than this use this table with the correction factors from Table B-2.
- 2) These values assume that workers drink frequently and have properly increased salting of food prior to exposure.
- 3) These values are guidelines. Actual levels may be modified based on individual physiological response and actual work and rest conditions.
- 4) These values assume that the rest location is cool enough to alleviate heat load conditions.

ATTACHMENT B (Page 3 of 5)

WORK/REST REGIMENS AND MONITORING

Table B-2. Correction Factors for Table B-1 in °F*

Clothing Type	WBGT Correction
Summer work uniform	0
Cotton overalls	-3.5
Winter work uniform	-7
Water barrier, permeable	-11
Condition	WBGT Correction
Unacclimatized worker, moderate work load	-4.5

^{*}To use this table, identify the most restrictive applicable clothing type and whether unacclimatized workers are involved. Add the two. Modify Table B-1 temperatures by this amount. For example, the Table B-1 TLV for continuous work, light workload is 86oF. If cotton overalls (-3.5) are work and acclimatized workers are acclimatized (no additional change) the modified limit is 82.5oF.

B. WBGT Determination

If the Wet Bulb Globe Temperature (WBGT) is used to determine if field conditions are conducive to heat stress illnesses, the WBGT is determined through the following equations:

Outdoors with solar load:
 (1)

WBGT=0.7 NWB+0.2GT+0.1DB

• Indoors or outdoors with no solar load: (2)

WBGT=0.7 NWB+0.3GT

Where:

WGBT = Wet Bulb Globe Temperature Index

NWB = Natural Wet-Bulb Temperature

DB = Dry-Bulb Temperature

GT = Globe Thermometer Temperature

ATTACHMENT B (Page 4 of 5)

WORK/REST REGIMENS AND MONITORING

The factors involved in the above equations can be measured in the following manner:

- Through the use of a direct-reading heat stress monitor capable of measuring all of the individual factors associated with the WBGT equation. For example, the Reuter-Strokes Wibet No. RSS-214 heat stress monitor.
- By measuring the individual factors manually using the following type of equipment

Natural Wet-Bulb Temperature Thermometer Dry-Bulb Temperature Thermometer Globe Temperature Thermometer Stand

III. Adjusted Temperature Based Work/Rest Regimens

When wearing impermeable protective clothing, the use of work/rest regimens based on WBGT is not recommended. The WBGT index is designed to account for the effects of evaporative cooling. Vapor barrier clothing impedes the evaporation of sweat and renders the WBGT an inappropriate physiological model. The most important environmental conditions related to heat stress for workers wearing impermeable protective clothing have been suggested to be the ambient dry bulb temperature and the radiant solar heat. These factors are combined into an index called the adjusted temperature using the following formula:

 T° adjusted = ambient dry bulb temperature + (13 x % sunshine)

where % sunshine is an estimate of the amount of time the sun is covered by clouds thick enough to produce a shadow. The thermometer bulb should be shielded from radiant heat when taking measurements.

The adjusted temperature values are then used to determine the initial work/rest regimen and physiological monitoring frequency. Table B-3 gives the work period and monitoring frequency. Initially, rest periods will be at least 15 minutes. Physiological monitoring that is normally recommended is pulse rate and body temperature. Procedures for each are described below. Initially, both should be done. Pulse rate monitoring may be discontinued with the approval of the PESM if temperature monitoring proves to be effective.

ATTACHMENT B (Page 5 of 5)

WORK/REST REGIMENS AND MONITORING

A. Pulse Rate Monitoring

Take the pulse immediately at the start of the rest period (P1). Take the pulse again 2 1/2 to 3 minutes into the rest period (P2). If any of the following conditions exist, shorten the next work period by a third:

P1 > 110 beats per minute(bpm)

P2 > 90 bpm

P1 - P2 < 10 bpm.

Pulse rates can be taken with an electronic pulse meter, or manually with a stopwatch for 30 seconds.

B. Oral Temperature

Take the oral temperature immediately at the start of the rest period. If the oral temperature exceeds 99.50 shorten the next work period by a third. Do not return the worker to hot work in semipermeable or impermeable clothing until the oral temperature is less than 99.50F.

Oral temperatures may be taken with disposable oral thermometers or infrared ear drum scanners, such as the Thermoscan. Note: If a Thermoscan unit is purchased, the Pro Model should be selected. The home model available through drugstores cannot be recalibrated.

C. Removal from Exposure

If an individual requires a shortening of the work period on more than two consecutive monitoring periods, or repeatedly over a few days, they should be removed from exposure to hot environments wearing semipermeable impermeable protective clothing until examined and cleared for such work by the consulting physician.

Table B-3. Initial Work Period and Physiological Monitoring Frequency ¹

ADJUSTED TEMPERATURES	SCHEDULE
90°F or above	15 minutes
87.5° - 90° F	30 minutes
82.5°- 87.5°F	60 minutes
77.5° - 82.5°F	90 minutes
70° - 77.5°F	120 minutes

Schedule is for fit and acclimatized workers in impermeable protective clothing.

EHS 6-2:

Drill Rigs (Previously HS6-3)

The purpose of this program is to establish drilling safety auidelines.

Version Date: 03/19/98 - Revised Original Issue 02/01/95

Date:

Department/Category: Environmental, Health &

Safety - Programs

Document Type: Procedure

Keyword Index: EHS Compliance/Waste

Management, Field Activities/Science, Operational Control,

Training

Approved by:

FOSTER WHEELER ENVIRONMENTAL CORPORATION

NOTICE OF OWNERSHIP AND CONDITIONS OF USE

This document is the property of Foster Wheeler Environmental Corporation (FWENC) and is loaned for use subject to recall for any reason at any time without prior notice and with the distinct understanding that it is to be used only for the duration of and in connection with the performance of work for FWENC. Please observe that the material herein is copyrighted and protected by the laws pertaining to copyright.

Should any circumstances arise under which you will no longer require this document for the specific purpose for which it is loaned to you, it must be returned promptly. Under no circumstance shall this document be transferred or loaned to any other individual, firm, or corporation without the express written permission of the CEO or designee.

In the event such permission is obtained, the person who obtains such permission shall be responsible for obtaining compliance with the conditions set forth in this Notice by any person to whom he/she may loan this document.

This document will be updated periodically as new concepts and practices are developed. Such revisions shall be effected by issuing new or revised sections to ensure uniform practices. Deviations to the enclosed information may be authorized, when appropriate, based upon warranted circumstances.

Sections shall not be removed from this document except as required by revisions or cancellations. Employees are not to rely on printed versions of this document and shall refer to the Lotus Notes database for the most current requirements.

> Copyright @ 1995, 1998 Foster Wheeler Environmental Corporation **Proprietary Information**

Table of Contents

Section

- 1.0 PURPOSE
- 2.0 SCOPE
- 3.0 MAINTENANCE
- 4.0 DEFINITIONS
 - 4.1 Annular Space
 - 4.2 Auger Rig
 - 4.3 Cable Tool Drilling
 - 4.4 Cathead
 - 4.5 Cribbing
 - 4.6 Cuttings
 - 4.7 Derrick
 - 4.8 Mud
 - 4.9 Rotary Drilling
 - 4.10 Sheave
- 5.0 DISCUSSION
 - 5.1 Responsibilities
 - 5.1.1 All FWENC Employees and Subcontractor Personnel
 - 5.1.2 Line Management
 - 5.2 Housekeeping
 - 5.3 Maintenance
 - 5.4 Hand Tools
 - 5.5 Clearing the Work Area
 - 5.6 Start-up
 - 5.7 Safety During Drilling Operations
 - 5.8 Safe Use of Wire Line Hoists, Wire Rope and Hoisting Hardware
 - 5.9 Safe Use of Cathead and Rope Hoists
 - 5.10 Safe Use of Augers
 - 5.11 Safety During Rotary and Core Drilling
 - 5.12 Engines and Pumps
 - 5.13 Safety During Travel
 - 5.14 Off-Road Movement
 - 5.15 Tires, Batteries and Fuel
 - 5.16 Drill Rig Utilization and Alterations
- 6.0 REFERENCES

1.0 **PURPOSE**

The purpose of this program is to establish drilling safety guidelines.

2.0 SCOPE

The requirements of this program apply to all drillers and drilling subcontractors working on Foster Wheeler Environmental Corporation (FWENC) projects. This program contains requirements for drilling, servicing and related operations performed in support of monitoring well installation and geological exploration, and addresses hazards associated with assembling and disassembling rigs, rotary and auger drilling, and grouting.

3.0 **MAINTENANCE**

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with FWENC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Director, Administration and Compliance.

4.0 **DEFINITIONS**

4.1 **Annular Space**

The space surrounding the pipe suspended in the wellbore. The outer wall of the annular space may be an open hole or it may be larger pipe.

4.2 **Auger Rig**

Drilling method in which a hole is drilled by rotating a corkscrew type hollow stem steel drill.

4.3 Cable Tool Drilling

Drilling method in which hole is drilled by advancing a drive barrel and/or hand tool. As the hole is advanced a steel casing is driven by a cable to prevent collapse.

4.4 Cathead

A spool-shaped extension of the draw works shaft used to lift heavy equipment and to make up or break out drill pipe.

4.5 Cribbing

Logs, 2 X 4s or other non-compressible material used to support an object above the ground/floor.

4.6 Cuttings

Soil or other particles obtained during drilling operations. Cuttings are brought to the surface by circulating mud-laden fluid in rotary drilling or by hollow stem auger drilling. They are bailed out in cable tool drilling.

4.7 Derrick

Any one of a large number of types of load-bearing structures. In drilling work, the standard derrick has four legs standing at the corners of the substructure and reaching to the crown block. The substructure is an assembly of heavy beams used to elevate the derrick above the ground and provide space to install blowout preventers, casing heads, etc. The standard derrick has largely been replaced by the mast for drilling. The mast is lowered and raised without disassembly.

4.8 Mud

The liquid that is circulated through the wellbore during rotary drilling and workover operations. In addition to its function of bringing cuttings to the surface, mud also cools and lubricates the bit and drill string, protects against blowouts by containing subsurface pressures, and deposits a mud cake on the wall of the borehole to prevent loss of fluids to the formations. Although it originally was a suspension of earth solids, especially clays, in water, the mud used in modern drilling operations is a somewhat more complex three-phase mixture of liquids, reactive solids, and inert solids. The liquid phase may be fresh water, diesel oil, or crude oil and may contain one or more conditioners.

4.9 Rotary Drilling

The drilling method by which a hole is drilled by a rotating bit to which a downward force (drill collars) is applied. The bit is fastened to and rotated by the drill stem, which also provides a passage for the circulating fluid.

4.10 Sheave

A wheel or disc with a grooved rim, especially one used as a pulley.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 All FWENC Employees and Subcontractor Personnel

All FWENC personnel are responsible for understanding and complying with the requirements of this program. They should bring all perceived, potential or actual unsafe site conditions to the attention of the Environmental and Safety Supervisor (ESS) during site safety meetings. Drillers are required to have their own drilling safety plan on-site which shall reference and comply with this procedure.

5.1.2 Line Management

The Project Manager (PM) is responsible for selecting a qualified drilling subcontractor for the project and has overall responsibility for the health and safety of all FWENC and subcontractor employees on the job site. The PM shall include this procedure and other appropriate health and safety requirements in all drilling specifications.

5.2 Housekeeping

The drilling safety supervisor shall understand and fulfill the responsibility for proper maintenance and good "housekeeping" on and around the drill rig. These requirements include, but are not limited to:

- Provide suitable storage locations for all tools, materials and supplies so that tools, materials and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.
- Avoid storing or transporting tools, materials or supplies within or on the mast (derrick) of the drill rig.
- Neatly stack pipe, drill rods, casing augers and similar drilling tools on racks or sills to prevent spreading, rolling or sliding.
- Place penetration or other driving hammers at a safe location on the ground or secure them to prevent movement when not in use.
- Keep work areas, platforms, walkways, scaffolding and other access ways free of materials, debris, and obstructions and substances such as ice, grease or oil that could cause a surface to become slick or otherwise hazardous.
- Keep all controls, control linkages, warning and operation lights and lenses free of oil, grease and/or ice.
- Do not store gasoline in any portable container other than a non-sparking, approved
 container with a flame arrester in the fill spout and having the word "gasoline" easily visible.
 A hazard communication label shall also be placed on all gasoline cans. (See EHS 4-2,
 Hazard Communications, and EHS 3-7, Hazardous Material Storage and Transportation.)

5.3 Maintenance

Proper maintenance will make drilling operations safer. Maintenance should be performed safely. These requirement include, but are not limited to:

- Keep drill rigs and associated equipment in good condition.
- Wear safety glasses when performing maintenance on a drill rig or on drilling tools.
- Shut down the drill rig engine to make repairs or adjustments to a drill rig or to lubricate
 fittings (except repairs or adjustments that can only be made with the engine running). Take
 precautions to prevent accidental starting of an engine during maintenance by locking,
 removing or tagging the ignition key (see EHS 6-4 Lockout/Tagout Procedure).
- Always block the wheels or lower the leveling jacks or both and set hand brakes before working under a drill rig.
- When possible and appropriate, release all pressure on the hydraulic systems, the drilling fluid system and the air pressure systems of the drill rig prior to performing maintenance. In other words, reduce the drill rig and operating systems to a "zero energy state" before performing maintenance. Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.
- Do not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have had adequate time to cool.
- Never weld or cut on or near a fuel tank.
- Do not use gasoline or other volatile or flammable liquids as a cleaning agent on or around a drill rig.
- Follow the manufacturer's recommendations for applying the proper quantity and quality of lubricants, hydraulic oils and/or coolants.
- Replace all caps, filler plugs, protective guards or panels and high pressure hose clamps and chains or cables that have been removed for maintenance before returning the drill rig to service.
- Check the deadman switch daily. Ensure that its location is known to all drill rig crew personnel.

5.4 Hand Tools

There are almost an infinite number of hand tools that can be used on or around a drill rig and in repair shops and more than an equal number of instructions for proper use. "Use the tool for its intended purpose" is the most important rule. The following are a few specific and some general suggestions which apply to safe use of hand tools that are often used on and around drill rigs.

- When a tool becomes damaged, either repair it before using it again or discard it.
- When using a hammer wear safety glasses and require all others around you to wear safety

glasses.

- When using a chisel wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and neatly stored when not in use.
- Use wrenches on nuts do not use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease which would otherwise build up and cause wrenches to slip.
- Never use pipe wrenches in place of a rod holding device.
- · Replace hook and heel jaws when they become visibly worn.
- When breaking tool joints on the ground or on a drilling platform, position your hands so that
 your fingers will not be smashed between the wrench handle and the ground or the platform,
 should the wrench slip or the joint suddenly let go.

5.5 Clearing the Work Area

Prior to drilling, perform adequate site clearing and leveling to accommodate the drill rig and supplies and provide a safe working area. Drilling shall not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

5.6 Start-up

- Instruct all visitors to "stand clear" of the drill rig immediately prior to and during starting of any an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers
 are in the correct non-actuating positions and the cathead rope is not on the cathead before
 starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

5.7 Safety During Drilling Operations

- Safety requires the attention and cooperation of every worker and site visitor.
- Do not drive the drill rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick), look up to check for overhead obstructions.
- Maintain a minimum of 15 ft clearance from all overhead electric lines. See Army Corps of Engineers, EM 385-1-1, Section 11.E for additional guidance on operations adjacent to overhead lines.
- Before raising the mast (derrick), all drill rig personnel (with the exception of the operator) and visitors shall be cleared from the areas immediately to the rear and the sides of the mast. All drill rig personnel and visitors shall be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig must first be leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig shall be re-leveled if it settles after initial set up. Lower the mast (derrick) only when the leveling jacks are down and do not raise the leveling jack pads until the mast (derrick) is lowered completely.
- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.
- The operator of a drill rig shall only operate a drill rig from the position of the controls. If the
 operator of the drill rig must leave the area of the controls, the operator shall shift the
 transmission controlling the rotary drive into neutral and place the feed control lever in
 neutral. The operator shall shut down the drill engine before leaving the vicinity of the drill
 rig.
- Throwing or dropping tools shall not be permitted. All tools shall be carefully passed by hand between personnel or a hoist line shall be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.
- When encountering a "hot spot" during drilling operations involving volatiles, vacate the immediate area and allow the borehole to vent. Resume work after monitoring instruments indicate an atmosphere in compliance with the site-specific EHS Plan.
- If it is necessary to drill within an enclosed area, make certain that exhaust gases are vented out of the area. Exhaust gases can be toxic and some cannot be detected by smell.
- Clean mud and grease from your boots before mounting a drill platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the drill rig with exposed flesh.
 Freezing of moist skin to metal can occur almost instantaneously.
- All air and water lines and pumps should be drained when not in use if freezing weather is expected.

- All unattended boreholes must be adequately covered or otherwise protected to prevent drill
 rig personnel, site visitors or animals from stepping or falling into the hole. All open
 boreholes shall be covered, protected or backfilled adequately and according to local or state
 regulations on completion of the drilling project.
- "Horsing around" within the vicinity of the drill rig and tool and supply storage areas is not allowed, even when the drill rig is shut down.
- When using a ladder on a drill rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool "bucket" or a safety hook to raise or lower hand tools.
- Use elevated derrick platforms with the following precautions:
 - When working on a derrick platform, use a safety harness and a lifeline. The safety harness shall be at least four inches (100 mm) wide and shall fit snugly but comfortably. The lifeline, when attached to the derrick, shall be less than six feet (2 m) long. The safety harness and lifeline shall be strong enough to withstand the dynamic force of a 250 pound (115 kg) weight (contained within the belt) falling six feet (2 m).
 - When climbing to a derrick platform that is higher than 20 feet (6 m), use a safety climbing device.
 - When a rig worker is on a derrick platform, fasten the lifeline to the derrick just above the derrick platform and to a structural member that is not attached to the platform or to other lines or cables supporting the platform.
 - When a rig worker first arrives at a derrick platform, inspect the platform for broken members, loose connections and loose tools or other loose materials.
 - Attach tools securely to the platform with safety lines. Do not attach a tool to a line attached to your waist or any other part of your body.
 - When you are working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.
 - Do not leave loose tools and similar items on the derrick platform or on structural members of the derrick.
 - A derrick platform over four feet (1.2 m) above ground surface shall be equipped with toe boards and safety railings that are in good condition.
 - Workers on the ground or the drilling floor shall avoid working under rig workers on elevated platforms, whenever possible.
- Terminate drilling operations during an electrical storm and move the entire crew away from the drill rig.

5.8 Safe Use of Wire Line Hoists, Wire Rope and Hoisting Hardware

- The use of wire line hoists, wire rope and hoisting hardware shall be as stipulated by 29 CFR 1910, 29 CFR 1926, and the American Iron Steel Institute Wire Rope Users Manual.
- Visually inspect all wire ropes and fittings during use and thoroughly inspect them at least once a week for: abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion and damage to lifting hardware. Replace wire ropes when inspection indicates excessive damage according to the Wire Rope Users Manual. Thoroughly inspect all wire ropes which have not been used for a period of a month or more before returning them to service.
- End fittings and connections consist of spliced eyes and various manufactured devices.
 Install all manufactured end fittings and connections according to the manufacturer's instructions and follow the manufacturer's load specifications.
- If a ball-bearing type hoisting swivel is used to hoist drill rods, inspect and lubricate the swivel daily to assure that the swivel freely rotates under load.
- If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1 foot (0.3 m) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints and do not make up, tighten or loosen tool joints while the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to break the fall of the rods with your hands or by tensioning the slipping device.
- Most sheaves on exploration drill rigs are stationary with a single part line. Never increase
 the number of parts of line without first consulting with the manufacturer of the drill rig.
- Wire ropes must be properly matched with each sheave if the rope is too large, the sheave will pinch the wire rope - if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger sized wire ropes.
- The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware:
 - Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling).
 Do not use tool handling hoists to pull objects away from the drill rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.
 - When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.
 - When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far away as possible from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.
 - Minimize shock loading of a wire rope apply loads smoothly and steadily.
 - Avoid sudden loading in cold weather.

- Never use frozen ropes.
- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.
- Replace damaged safety latches on safety hooks before using.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Inspect and test clutches and brakes of hoists periodically.
- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles and other lifting aids.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up and when the load is being hoisted.
- Never hoist the load over the head, body or feet of any personnel.
- Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replacement wire ropes should conform to the drill rig manufacturer's specifications.

5.9 Safe Use of Cathead and Rope Hoists

The following safety procedures shall be employed when using a cathead hoist:

- Keep the cathead clean and free of rust and oil and/or grease. Clean the cathead with a wire brush if it becomes rusty.
- Check the cathead periodically, when the engine is not running, for rope wear grooves. Replace the cathead if a rope groove forms to a depth greater than 1/8 inch (3 mm).
- Always use a clean, dry, sound rope. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.
- Should the rope "grab" the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator shall also back away and stay clear. If the rope "grabs" the cathead, and tools

are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator shall keep careful watch on the suspended tools and shall quickly back away after turning off the engine.

- The rope shall always be protected from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.
- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg or any other part of your body.
- Always maintain a minimum of 18 inches of clearance between the operating hand and the
 cathead drum when driving samplers, casing or other tools with the cathead and rope
 methods. Be aware that the rope advances toward the cathead with each hammer blow as
 the sampler or other drilling tool advances into the ground.
- Never operate a cathead (or perform any other task around a drill rig) with loose unbuttoned or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.
- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not use more rope wraps than are required to hoist a load.
- Do not leave a cathead unattended with the rope wrapped on the drum.
- Position all other hoist lines to prevent contact with the operating cathead rope.
- When using the cathead and rope for driving or back-driving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.
- The cathead operator must be able to operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

5.10 Safe Use of Augers

The following general procedures shall be used when starting a boring with a continuous flight or hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear and the engine running at low RPM.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control

and repeat the hole starting process.

- An auger guide can facilitate the starting of a straight hole through hard ground or pavement.
- The operator and tool handler shall establish a system of responsibility for the various
 activities required for auger drilling, such as connecting and disconnecting auger sections,
 and inserting and removing the auger fork. The operator must assure that the tool handler is
 well away from the auger column and that the auger fork is removed before starting rotation.
- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over other auger sections or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatsoever.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

5.11 Safety During Rotary and Core Drilling

- Rotary drilling tools shall be safety checked prior to drilling:
 - Lubricate and check water swivels and hoisting plugs for "frozen" bearings before use.
 Use only approved lubrication fluids.
 - Check drill rod chuck jaws periodically and replace when necessary.
 - Check the capacities of hoists and sheaves against the anticipated weight to the drill rod string plus other expected hoisting loads.
- Special precautions for safe rotary or core drilling involve chucking, joint break, hoisting and lowering of drill rods:
 - Only the operator of the drill rig shall brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
 - Do not brake drill rods during lowering into the hole with drill rod chuck jaws.
 - Do not hold or lower drill rods into the hole with pipe wrenches.
 - If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.

- In the event of a plugged bit or other circulation blockage, relieve or bleed down the high pressure in the piping and hose between the pump and the obstruction before breaking the first tool joint.
- When drill rods are hoisted from the hole, they shall be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.
- If work must progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit shall be equipped with rough surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Do not lean unsecured drill rods against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

5.12 Engines and Pumps

- The following engine and pump stop devices are as follows:
 - For an internal-combustion engine; an ignition or grounding switch.
 - For a diesel engine: a quick-closing valve or equivalent device which will shut off the air to the air-intake manifold of the engine and prevent entry of gas-laden air, or a means of releasing the engine compression which will not produce an open flame or spark.
 - For an electric motor: a suitable switch in the motor circuit, or a switch or stop button in the control circuit, approved for the location in which it is installed.
- Mud pumps shall be equipped with a pressure relieving device set to release within the limits
 of the safe working pressure of the pump. Such devices include direct spring-loaded safety
 valves, shear-pin safety valves, and rupture disks.
- There shall be no valve between the pump and its pressure-relieving device. The point of discharge from a pressure-relieving device shall be located where employees are not endangered by the discharge of fluids.
- Each pump shall be equipped with bleeder valves.
- All personnel involved in the operation of the rig shall know the <u>exact</u> location of each stop device.

5.13 Safety During Travel

- The individual who transports a drill rig on and off a drilling site shall:
 - Be properly licensed and shall only operate the vehicle according to federal, state and local regulations.
 - Know the traveling height (overhead clearance), width, length and weight of the drill rig with carrier and know the highway and bridge load, width and overhead limits, making sure these limits are not exceeded and allowing an adequate margin of safety.
 - Never move a drill rig unless the vehicle brakes are in sound working order.
 - Allow for mast overhang when cornering or approaching other vehicles or structures.
 - Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.
 - Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels or other commercial sites.
 - Never travel on a street, road, highway with the mast (derrick) of the drill rig in the raised or partially raised position.
 - Remove all ignition keys when a drill rig is left unattended.

5.14 **Off-Road Movement**

- The following safety precautions relating to off-road movement shall be followed:
 - Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gullies, ruts and similar obstacles.
 - Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven or hilly ground.
 - Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts and mountings.
 - Discharge all passengers before moving a drill rig on rough or hilly terrain.
 - Engage the front axle (for 4 x 4, 6 x 6, etc. vehicles or carriers) when traveling off highway on hilly terrain.
 - Use caution when traveling a side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of gravity. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
 - Attempt to cross obstacles such as small logs and small erosion channels or ditches

squarely, not at an angle.

- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.
- After the drill rig has been moved to a new drilling site, set all brakes and/or locks and block wheels.
- Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.

5.15 Tires, Batteries and Fuel

- Tires on the drill rig must be checked daily for safety and during extended travel for loss of air and they must be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be reinflated to normal pressures before movement on firm or hilly ground or on streets, roads and highways. Under inflated tires are not as stable on firm ground as properly inflated tires. Air pressures shall be maintained for travel on streets, roads and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:
 - Missing or loose wheel lugs
 - Objects wedged between duals or embedded in the tire casing
 - Damaged or poorly fitting rims or rim flanges
 - Abnormal or uneven wear and cuts, breaks or tears in the casing.
- The repair of truck and off-highway tires shall only be made with required special tools
 following the recommendations of a tire manufacturer's repair manual. If they are split rim
 tires, repairs shall be performed using an appropriate tire cage device.
- Batteries contain strong acid. Use extreme caution when servicing batteries.
 - Batteries shall only be serviced in a ventilated area while wearing safety glasses.
 - When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
 - When installing a battery, connect the battery ground clamp last.
 - When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger leads to the battery posts. Loosen cell caps prior to charging to permit the escape of gas.
 - Spilled battery acid can burn your skin and damage your eyes. Spilled battery acid shall be immediately flushed off your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a medical physician at once.
 - To avoid battery explosions, keep the cells filled with electrolyte, use a flashlight (not an open flame) to check electrolyte levels, and avoid creating sparks around the battery by

shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

- Special precautions must be taken for handling fuel and refueling the drill rig or carrier.
 - Only use the type and quality of fuel recommended by the engine manufacturer.
 - Refuel in a well-ventilated area.
 - Do not fill fuel tanks while the engine is running. Turn off all electrical switches.
 - Do not spill fuel on hot surfaces. Clean any spillage before starting an engine.
 - Wipe up spilled fuel with cotton rags or cloths do not use wool or metallic cloth.
 - Keep open lights, lighted smoking materials and flames or sparking equipment well away from the fueling area.
 - Turn off heaters in carrier cabs when refueling the carrier or the drill rig.
 - To allow for expansion of the fuel during temperature changes, do not fill portable fuel containers completely full.
 - Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.
 - Do not transport portable fuel containers in the vehicle or carrier cab with personnel.
 - Fuel containers and hoses shall remain in contact with a metal surface during travel to prevent the buildup of static charge.

5.16 Drill Rig Utilization and Alterations

- Do not attempt to exceed manufacturer's ratings of speed, force, torque, pressure, flow, etc. Only use the drill rig and tools for the purposes which they are intended and designed.
- Alterations to a drill rig or drilling tools shall only be made by qualified personnel and only
 after consultation with the manufacturer.

6.0 REFERENCES

American Iron Steel Institute, Wire Rope Users Manual.

Drilling Safety Guide. 3008 Millwood Avenue, Columbia, S.C. 29205.

Environmental, Health & Safety Programs EHS 3-7, Hazardous Material Storage and Transportation

Environmental, Health & Safety Programs EHS 4-2, Hazard Communications

Environmental, Health & Safety Programs EHS 6-4, Lockout/Tagout 3

National Drilling Federation

OSHA (Occupational Safety and Health Administration)

29 CFR 1910

29 CFR 1926

USACOE (U.S. Army Corps of Engineers), EM 385-1-1, 11.E, Operations Adjacent to Overhead

Lines. Safety and Health Requirements Manual.

EHS 6-3:

Excavation and Trenching (Previously HS6-4)

This program provides the requirements for activities involving excavations in accordance with 29 CFR 1926, Subpart P -

Version Date: 03/19/98 - Revised Original Issue 02/01/95

Date:

Department/Category: Environmental, Health &

Safety - Programs

Document Type: Procedure

Keyword Index: EHS Compliance/Waste Management, Field Activities/Science, Operational Control,

Training, Monitoring

Approved by:

FOSTER WHEELER ENVIRONMENTAL CORPORATION

NOTICE OF OWNERSHIP AND CONDITIONS OF USE

This document is the property of Foster Wheeler Environmental Corporation (FWENC) and is loaned for use subject to recall for any reason at any time without prior notice and with the distinct understanding that it is to be used only for the duration of and in connection with the performance of work for FWENC. Please observe that the material herein is copyrighted and protected by the laws pertaining to copyright.

Should any circumstances arise under which you will no longer require this document for the specific purpose for which it is loaned to you, it must be returned promptly. Under no circumstance shall this document be transferred or loaned to any other individual, firm, or corporation without the express written permission of the CEO or designee.

In the event such permission is obtained, the person who obtains such permission shall be responsible for obtaining compliance with the conditions set forth in this Notice by any person to whom he/she may loan this document.

This document will be updated periodically as new concepts and practices are developed. Such revisions shall be effected by issuing new or revised sections to ensure uniform practices. Deviations to the enclosed information may be authorized, when appropriate, based upon warranted circumstances.

Sections shall not be removed from this document except as required by revisions or cancellations. Employees are not to rely on printed versions of this document and shall refer to the Lotus Notes database for the most current requirements.

> Copyright © 1995, 1998 Foster Wheeler Environmental Corporation Proprietary Information

Table of Contents

Section

- 1.0 PURPOSE
- 2.0 SCOPE
- 3.0 MAINTENANCE
- 4.0 DEFINITIONS
 - 4.1 Benching
 - 4.2 Competent Person
 - 4.3 Excavation
 - 4.4 Hazardous Atmosphere
 - 4.5 Protective Systems
 - 4.6 Sloping
 - 4.7 Support System
 - 4.8 Trench
- 5.0 DISCUSSION
 - 5.1 Responsibilities
 - 5.1.1 Competent Person
 - 5.1.2 Line Management
 - 5.1.3 Environmental, Health and Safety Personnel
 - **5.2 Designation of Competent Personnel**
 - 5.3 General Requirements
 - 5.4 Hazardous Atmospheres
 - 5.5 Protection From Water Hazards
 - 5.6 Stability of Adjacent Structures
 - 5.7 Daily Inspections
 - 5.8 Soil Classification
 - 5.9 Sloping and Benching
 - 5.10 Protective Systems
 - 5.11 Training
- 6.0 REFERENCES
- 7.0 ATTACHMENTS

1.0 PURPOSE

This program provides the requirements for activities involving excavations in accordance with 29 CFR 1926, Subpart P - Excavations.

2.0 SCOPE

These requirements are applicable to all Foster Wheeler Environmental Corporation (FWENC) operations.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with FWENC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Director, Administration and Compliance.

4.0 **DEFINITIONS**

4.1 Benching

A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

4.2 Competent Person

A competent person is one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

4.3 Excavation

Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

4.4 Hazardous Atmosphere

An atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

4.5 Protective Systems

A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

4.6 Sloping

A method of protecting employees from cave-ins by forming sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

4.7 Support System

A structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

4.8 Trench

A narrow excavation made below the surface of the ground. In general the depth is greater than the width, but the width of a trench measured at the bottom is not greater than 15 feet. If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet or less, the excavation is also considered to be a trench.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Competent Person

The competent person(s) shall be responsible for:

- Day-to-day oversight of open excavations and trenches
- Conducting soil classifications
- Selection of protective systems
- Conducting daily inspections of open excavations and trenches; and

 Providing the Environmental and Safety Supervisor (ESS) with all required documentation on a daily basis.

5.1.2 Line Management

The Project Manager (PM) shall be responsible for:

- Ensuring compliance with this procedure
- Providing the necessary resources for compliance with this procedure; and
- Designating competent personnel in consultation with the Project Environmental, Health and Safety Manager (PESM)

5.1.3 Environmental, Health and Safety Personnel

The ESS shall be responsible for:

- Providing oversight on the implementation of the requirements contained in this procedure
- Conducting periodic reviews of open trenches and excavations
- Consulting with the project manager and competent person on excavation issues; and
- Maintaining required records.

5.2 Designation of Competent Personnel

Prior to the start of any excavation work the project manager shall designate a competent person to fulfill the requirements of this procedure.

5.3 General Requirements

The following section provides general requirements governing activities in and around excavation and trenches, as well as the requirements for the selection and use of protective systems.

- Surfaces surrounding open trenches and excavations shall have all surface hazards removed.
- All utilities shall be located and cleared prior to initiating digging. Public or facility utility groups shall be utilized where possible for this purpose. In the absence of either, the ESS shall specify the procedures to be used to clear utilities in consultation with the project PESM and project manager. When the excavation is open, utilities shall be supported and protected from damage. Clearance and support methods shall be documented on the daily inspection checklist.
- Where structural ramps are used for egress they shall be installed in accordance with 29 CFR 1926.651(c)(1).

- Stairways, ladders, or ramps shall be provided as means of egress in all trenches 4 feet or more in depth. Travel distance shall be no more than 25 feet between means of exit.
- Employees exposed to vehicular traffic shall wear traffic vests.
- No employee shall be permitted under loads being lifted or under loads being unloaded from vehicles.
- When vehicles and machinery are operating adjacent to excavations warning systems such as stop logs or barricades shall be utilized to prevent vehicles from entering the excavation or trench.
- Scaling or barricades shall be used to prevent rock and soils from falling on employees.
- Excavated and loose materials shall be kept at least 3 feet from the edge of excavations.
- Walkways or bridges with standard railing shall be provided at points employees are to cross over excavations or trenches.
- Barriers shall be provided to prevent personnel from inadvertently falling into an excavation.

5.4 Hazardous Atmospheres

Where atmospheres containing less than 19.5 percent oxygen or other types of hazardous atmospheres may exist the following requirements shall be implemented.

- Atmospheric testing shall be done prior to employees entering excavations 4 feet or greater in depth.
- Testing methods shall be listed on the daily inspection checklist and results documented daily in field logs.
- Control measures such as ventilation and personal protective equipment (PPE) shall be used to control employee exposure to hazardous atmospheres below published exposure limits.
- Ventilation shall be used to control flammable and combustible vapors to below 10 percent of their lower explosive limit.
- Testing shall be repeated as often as necessary to ensure safe levels of airborne contaminants.
- Emergency equipment shall be provided and attended when the potential for a hazardous atmosphere exists. This equipment shall include but not be limited to emergency breathing apparatus, harnesses, lifelines, and basket stretchers. Required equipment will be listed on the daily inspection checklist and reviewed daily.

5.5 Protection From Water Hazards

When water has collected or is collected in excavations and trenches the following requirements shall be applied.

- Employees shall not work in excavations in which water has, or is, accumulating without the use of additional protection such as special support systems or water removal.
- Water removal shall be monitored by a competent person.
- Barriers such as ditches and dikes shall be used to divert runoff from excavations and trenches.
- Trenches shall be reinspected prior to re-entry after water accumulation due to heavy rainfall or seepage.

5.6 Stability of Adjacent Structures

When excavating or trenching near an adjacent structure the following practices shall be implemented.

- Support systems such as shoring, bracing, or underpinning shall be provided where the stability of buildings, walls, or other structures is endangered by excavation.
- Excavation bases or footings of foundations shall be prohibited unless support systems are
 used, the excavation is in stable rock, a professional engineer has determined the structure
 is sufficiently removed from the site as to not pose a hazard, or the PE determines that the
 excavation shall not pose a hazard to employees due to the structure.
- Support systems shall be used when it is necessary to undermine sidewalks, pavements, and appurtenant structures.
- Surcharge load sources and adjacent encumbrances shall be listed with their evaluation date on the daily inspection checklist.

5.7 Daily Inspections

Inspections shall be performed daily on all excavations, adjacent areas, and protective systems before personnel enter the trench. The checklist provided in Attachment A or equivalent shall be used.

5.8 Soil Classification

To perform soil classification, the competent person shall use a thumb test, pocket penetrometer, or shear vane to determine the unconfined compressive strength of the soils being excavated. In soils with properties that change (i.e., one soil type mixed with another within a given area) several tests may be necessary. When different soil types are present the overall classification shall be that of the type with the lowest unconfined compressive strength. Classifications shall result in a soil rating of Stable Rock, Type A, Type B, or Type C in accordance with 29 CFR 1926.652, Appendix A. Soil classifications shall be listed on the daily inspection checklist. The

soils analysis checklist provided in Attachment B or equivalent shall be used for soil classifications.

5.9 Sloping and Benching

All sloping and benching shall be done in accordance with 29 CFR 1926.652, Appendix B. Selection of the sloping method and evaluation of surface surcharge loads shall be made by a competent person familiar with the requirements contained therein. Sloping and benching methods and specifications shall be listed on the daily inspection checklist.

5.10 Protective Systems

Protective systems are required on all excavations over 5 feet in depth or in excavations less than 5 feet when examination of the ground by a competent person reveals conditions that may result in cave-ins.

Selection and installation of protective systems shall be done in accordance with 29 CFR 1926.652, Appendices C & D, or manufacturers data for shoring and shielding systems. Selection of a protective system shall be made based upon soil classification and job requirements by a competent person. Protective systems and specifications shall be listed on the daily inspection checklist.

5.11 Training

Competent persons shall have an adequate combination of experience and training to classify soil types and select protective systems as outlined in 29 CFR 1926.652. Training and experience pertaining to qualification as a competent person shall be documented and include the following:

- General safety practices related to working in or near open excavations;
- Inspection requirements and techniques;
- Classification of soils in accordance with 29 CFR 1926.652, Appendix A; and
- Uses, limitations, and specifications of protective systems in accordance with 29 CFR 1926.652.

Training records shall be maintained in accordance with EHS 1-9, Recordkeeping.

6.0 REFERENCES

Environmental, Health & Safety Programs EHS1-9, Recordkeeping (OSHA (U.S. Department of Labor, Occupational Safety and Health Administration), 29 CFR 1926, Subpart P, Excavations.

7.0 ATTACHMENTS

Attachment A - Daily Excavation Inspection Checklist Attachment B - Soils Analysis Checklist



FOSTER WHEELER ENVIRONMENTAL CORPORATION

DAILY EXCAVATION INSPECTION CHECKLIST To be completed by a "Competent Person"

Site	locati	on								
Date Time Competent Person										
	Type									
		sification(s)	Excavation depth	Excavation width						
Тур	e of p	rotective system used								
Indi	cate f	or each item by circling: Y (Ye.	s), N (No), - Address in Comments, I	Not Applicable (N/A.)						
I.	Gen	eral Inspection of Job Site								
	Α.	Surface encumbrances remove		Y	N	N/A				
	B.	Employees protected from loc	ose rock or soil that could pose a							
		hazard by falling or rolling in		Y	N	N/A				
	C.	Hard hats worn by all employ		Y	N	N/A				
	D.		nent set back at least 2 feet from the	edge						
		of the excavation		Y	N	N/A				
	E.		tely located excavations, wells, pits,		N	N/A				
	F.		xcavations 4 feet or more in depth ar							
		equipped with standard guard		Y	N	N/A				
	G.		visible clothing provided and worn							
		by all employees exposed to p		Y	N	N/A				
	H.		and utilized when mobile equipment							
		operated near the edge of the		Y	N	N/A				
	I.		orking on the faces of sloped or							
		benched excavations above ot	her employees	Y	N	N/A				
II.		lities								
		Utility companies contacted a		Y	N	N/A				
			ked when approaching the utilities	Y	N	N/A				
	C.	•	otected, supported or removed when	excavation						
		is open		Y	N	N/A				
Ш.	. Means of Access and Egress									
	A.	Lateral travel to means of egr	ess no greater than 25 feet in							
		excavations 4 feet or more in	depth	Y	N	N/A				
	B.	Ladders used in excavations s	secured and extended 3 feet above							
		the edge of the trench		Y	N	N/A				
	C.	Structural ramps used by emp	oloyees designed by a competent pers	son Y	N	N/A				
	D.	Structural ramps used for equ	ipment designed by a registered							
		professional engineer (RPE)		Y	N	N/A				
	E.		ds of uniform thickness, cleated toge							
		the bottom, equipped with a n		Y	N	N/A				
	F.	Employees protected from cav	ve-ins when entering or exiting the e	excavation Y	N	N/A				

IV.	Wet	Conditions			
	A.	Precautions taken to protect employees from the accumulation of water	Y	N	N/A
	B.	Water removal equipment monitored by a competent person	Y	N	N/A
	C.	Surface water or runoff diverted or controlled to prevent accumulation			
		in the excavation	Y	N	N/A
	D.	Inspections made after every rainstorm or other hazard increasing occurrence	Y	N	N/A
w 7	TT	and ma Atheres haves			
V.		ardous Atmospheres Atmosphere within the excavation tested where there is a reasonable			
	Α.	· ·			
		possibility of an oxygen deficiency, combustible or other harmful	v	NT	N/A
	D	contaminant exposing employees to a hazard	Y Y	N	
	B.	Ventilation	Y	N	N/A
	C.	Testing conducted often to ensure that the atmosphere remains safe	ĭ	N	N/A
	D.	Emergency equipment, such as breathing apparatus, safety harness and			
		line, and basket stretcher readily available where hazardous atmospheres			27/1
		could or do exist	Y	N	N/A
	E.	Safety harness and life line used and individually attended when entering			
		deep confined excavations	Y	N	N/A
VI.	Sun	port Systems			
-	A.	Materials and/or equipment for support systems selected based on soil			
		analysis, trench depth and expected loads	Y	N	N/A
	B.	Materials and equipment used for protective systems inspected and in			
	~.	good condition	Y	N	N/A
	C.	Materials and equipment not in good condition have been removed	_		
	О.	from service	Y	N	N/A
	D.	Damaged materials and equipment used for protective systems inspected	•	• •	- "
	D.	by a RPE after repairs and before being placed back into service	Y	N	N/A
	E.	Protective systems installed without exposing employees to the hazards	•	1,	1 1/1 1
	L.	of cave-ins, collapses or from being struck by materials or equipment	Y	N	N/A
	С		Y	N	N/A
	F.	Members of support system securely fastened to prevent failure	1	14	IV/A
	G.	Support systems provided to insure stability of adjacent structures,	Y	N	N/A
		buildings, roadways, sidewalks, walls, etc.			
	Η.	Excavations below the level of the base or footing approved by an RPE	Y	N	N/A
	I.	Removal of support systems progresses from the bottom and members are			
		released slowly as to note any indication of possible failure	Y	N	N/A
	J.	Backfilling progresses with removal of support system	Y	N	N/A
	K.	Excavation of material to a level no greater than 2 feet below the bottom of			
		the support system and only if the system is designed to support the loads			
		calculated for the full depth	Y	N	N/A
	L.	Shield system placed to prevent lateral movement	Y	N	N/A
	M.	Employees are prohibited from remaining in shield system during			
		vertical movement	Y	N	N/A
VΠ	Con	nments			
—					



FOSTER WHEELER ENVIRONMENTAL CORPORATION

SOILS ANALYSIS CHECKLIST

	rformed on eac	ch layer of so	il in excav	determine the soil type(s) prese ation walls. A separate analysis pe may change.	
Site location:					
Date:	Гіте:	Co	ompetent P	erson	
Where was the sample taken	from?				
				Length:	
VISUAL TEST					
Particle type:	Fine Grain	ned (cohesive)	Course grained (sand or grave	:1)
Water conditions:	Wet	Dry		Surface water present	Submerged
Previously disturbed soils?	Yes	No			
Underground utilities?	Yes	No		•	
Layered soils?	Yes	No			
Layered soil dipping into excavation?	Yes	No			
Excavation exposed to vibrations:	Yes	No			
Crack-like openings or spallings observed?	Yes	No			
Conditions that may create a hazardous atmosphere?	Yes	No			
If yes, identify condition	and source:				
Surface encumbrances:	Yes	No			
Work to be performed near public vehicular traffic?	Yes	No			
Possible confined space exposure?	Yes	No			
MANUAL TEST					
Plasticity:	Cohesive	Non-	cohesive		
Dry Strength	Granular (crumbles eas	ilv)	Cohesive (broken with difficu	ltv)

NOTE: The following unconfined compressive strength tests should be performed on undisturbed soils.
THUMB TEST (used to estimate unconfined compressive strength of cohesive soil)
Test performed: Yes No
Type A (soil indented by thumb with very great effort)
Type B (soil indented by thumb with some effort)
Type C (soil easily penetrated several inches by thumb with little or no effort). If soil is submerged, seeping water, subjected to surface water, runoff, exposed to wetting.
PENETROMETER OR SHEARVANE (used to estimate unconfined compressive strength of cohesive soils)
Test performed: Yes No
Type A (soil with unconfined compressive strength of 1.5 tsf or greater)
Type B (soil with unconfined compressive strength of 0.5 tsf to 1.5 tsf)
Type C (soil with unconfined compressive strength of 1.5 tsf or less). If soil is submerged, seeping water, subjected to surface water, runoff, exposed to wetting.
WET SHAKING TEST (used to determined percentage of granular and cohesive materials). Compare results to soil textural classification chart to determine soil type.
Test performed Yes No
Type A (clay, silty clay, sandy clay, clay loam, and in some cases silty clay, loam and sandy clay loam)
Type B [angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and in some cases, silty clay loam and sandy clay loam
Type C(granular soil including gravel, sand and loamy sand)
% granular % cohesive % silt
NOTE: Type A — no soil is Type " A " if soil is fissured; subject to vibration; previously disturbed; layered dipping into the excavation on a slope of $4H:1V$.
SOIL CLASSIFICATION
Type A
Type B
Type C
SELECTION OF PROTECTIVE SYSTEM
Sloping, Specify angle:
Timber Shoring
Aluminum Hydraulic Shoring

NOTE: Although OSHA will accept the above tests in most cases, some states will not. Check your state

safety requirements for trenching regulations.

300672